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The Proposed Increase in Annual Dues by the American Society of Mechanical Engineers.

We note with great satisfaction that the position assumed in our editorial, "A Union Engineering Society House," published in issue No. 34, is in direct accord with the views of "Engineering News," as published in the issue of that periodical for October 3. Our contemporary does us the honor of reprinting our editorial entire, and gives an editorial of its own, which is if anything stronger than our own. It points out, what is new to us, that to the membership at large the present dues of the American Society of Mechanical Engineers are equaled by but two engineering societies in the world, though some societies charge an additional fee for resident members living near the society headquarters, for which additional benefits are given. The proposed increase in the American Society of Mechanical Engineers' dues will make its dues to all members equal to the highest charged by any other society for resident members and far above those charged by any other society for the general membership.

The worst feature of the case lies in the manner in which the proposed increase is to be voted upon. Notice was read at Milwaukee last spring that the proposed change would be voted on at the coming meeting in this city, which means that it will be decided by those present at that meeting. This is, we believe, in accordance with the constitution, but it is obviously to the last degree unjust that such action should be taken otherwise than by a mail ballot. As our contemporary puts it:

"Except as members not present at Milwaukee may have been informed through the technical journals, they are still in ignorance of the fact that unless the Council's plan is voted down at the December meeting of the society they will have to either pay $10 additional per annum to the society, or forfeit their membership."

It is certainly an anomaly that such a thing should be possible, but, being possible, it appears to us that the most needed amendment to the constitution is not one providing for an increase of dues, but one which shall require a mail ballot on all propositions for its own amendment. The injustice of increasing the dues to all by a vote of the small portion of the membership which is present at any meeting, is so obvious that we shall be surprised if the proposition is not voted down. Whatever may be the wise action in the case, and whatever may be done under the constitution as it stands, it must be obvious to all that the only equitable thing to do with this proposition is to order it referred to the entire membership through a ballot by mail.

Regarding our suggestion that the house of the American Society of Civil Engineers be leased by the other societies and be used as a general engineering headquarters, our contemporary says:

"There is no reason whatever (unless it be possible petty jealousies between the governing bodies of the several societies) why the public audience rooms of the American Society of Civil Engineers' house should not be leased to and utilized by every engineering society which holds meetings in New York city. Indeed, one such organization, the New York Railroad Club, has already begun holding its meetings there. Further, we believe it would be practicable to add to that building in such a manner as to accommodate the office force of both the Mechanical Engineers and the Electrical Engineers, with the libraries of both societies. Such an engineering center would be far more attractive than the headquarters of any one society at present can be.

. . . . . .

"The fact is that jealousy between the different societies is too childish to be worth talking about. If the question were fairly submitted to the members of the American Society of Civil Engineers, whether they desired their house in New York to be made a joint headquarters for the chief national engineering societies, we have not the slightest doubt that the vote would be overwhelmingly in its favor. Yet the story goes that tentative proposals for such a joint headquarters were unceremoniously turned down by the Board of Direction of that society a few years ago.

. . . . . .

"The present Mechanical Engineers' house is sufficient for every present need of the society, save only the gatherings during the one week of the year when the annual meeting is held. But for that one week it is perfectly feasible to lease a suitable auditorium at a moderate rental. To erect a costly building for that alone would be to heap folly on absurdity."

The editors of "Engineering News" are, of course, widely acquainted among the members of the Civil Engineers' Society and may be fairly supposed to be acquainted with their general sentiments and temper. We are glad to know that they believe a proposition for joint occupancy would be well received. It would certainly seem that the idea of making their house a headquarters and rallying point for engineers of all classes should be in the highest degree attractive to the civil engineers. Their society is the oldest and in a sense the parent American engineering society, and to thus take the other societies under their wing, so to speak, might add to the attractiveness of the idea. Personally, we should favor joint ownership of the house, but in view of the advantages to be gained by joint occupancy and of the fact that the civil engineers have been the first to erect a suitable building, no one, we think, would begrudge them any feeling of paternal satisfaction that might come from sole ownership by them and rental by the others.

Steam Pump Convention.

Manufacturers are finding it more and more to their interest to hold occasional meetings of their representatives and leading men. A late convention of this kind was held by the Union Steam Pump Company, of Battle Creek, Mich., at which delegates were present from many sections of the country and from two foreign countries.

Representatives of a business in widely separated parts of the country meet widely varying conditions of trade, of custom and of prejudice, as well as entirely different classes of work to which the goods handled

are put, and there can be no doubt that such an exchange of experiences as may be made on occasions like this results in advantages to all concerned and, most of all, to the business represented.

The convention of Battle Creek occupied three days—September 24, 25 and 26. A list of papers had been prepared which were read and discussed. Among the subjects we notice: "Sawmill and Sugar House Work," "Air and Water Lifts," "Sinking and Mining Work," "Jet Condensers and their Uses," "Outside Packed Plunger Pumps," "Pumps for Creamery Work," "Economy In and How to Handle Hot Water," "Irrigation in the Arid Districts" and "Oil in California."

Such a program speaks for itself. The convention was held entirely at the expense of the company. The original feeling on the part of the delegates was one of anticipation over an outing and general good time, and it was greatly to their surprise that the occasion proved to be primarily one of profit rather than amusement. The whole affair was, in fact, successful beyond the most sanguine expectations of its promoters.

We have no doubt that in many lines of business occasional meetings of this kind would be very profitable to all and we shall be surprised if the practice does not increase. The home office of any business is necessarily acquainted with the experiences and qualifications of its representatives, and, where the trade is widely diversified in territory and has numerous specialties and adaptations to suit local needs, there should be no difficulty, with a little management at the home office, in arranging a program for such a meeting which should be attractive and profitable to all.

The Kronprinz Wilhelm.

In our previous issue we spoke of the enjoyable entertainment provided and the facilities for inspection afforded representatives of the press on the magnificent new steamer, "Kronprinz Wilhelm," of the North German Lloyd Steamship Company. Our readers will be interested in the additional particulars here given concerning her.

Her dimensions are 663 feet length, 66 feet beam, and 43 feet depth; her gross register tonnage is 15,000 and her displacement 21,300 tons. The new steamship has been built of the best German steel as a four-deck vessel, with numerous extras, and has received the highest class of the Germanic Lloyd Register. The exterior appearance of the steamer is the same as that of the express steamship "Kaiser Wilhelm der Grosse," and she is distinguished in the same way by four large smoke-stacks.

The accommodations for the first cabin passengers are placed amidships, on the main, upper and promenade decks and are provided with every possible comfort for the traveling public. Four *cabines de luxe*, composed of sitting-room, bed-room and bath-room, and eight apartments consisting of bed-room and bath-room, have been furnished for the accommodation of those who wish to travel luxuriously. A number of staterooms have been provided on the awning or bridge deck, which is the deck above the promenade deck. The passengers in these rooms receive the full benefit of light and air on the topmost deck of the steamer. The second cabin also shows that the comforts of this class have by no means been neglected.

Particular attention has been paid in the construction of this vessel to the adoption of the most advanced and perfect arrangements for safety. A double bottom that extends nearly the entire length of the steamer is divided into 24 water-tight compartments by 15 transverse bulkheads that extend to the upper deck, and by a longitudinal bulkhead in the engine room. To these safety arrangements should be added a large and extensive pumping plant of the most varied description, fire-extinguishing apparatus of every kind and a full equipment of boats, of which the steamer carries 24. The well-known Schlick system by which vibration is reduced to a minimum has been adopted on this steamer as on all the new vessels of the North German Lloyd, also bilge keels, to prevent excessive rolling. All compartments are electrically illuminated, 1,900 electric lamps being provided for this purpose, which are fed by 4 dynamos of 825 amperes and 100 volts.

The motive power consists of two 6-cylinder quadruple expansion engines, indicating 33,000 horse-power. The steam is furnished by 16 large boilers, of which 12 are double boilers and 4 single boilers. The coal consumption is about 500 tons per day. The bunkers hold 4,450 tons of coal and the crew consists of about 500 persons.

The arrangement of the first cabin dining-room is a masterpiece of interior architecture. The dining-room contains 414 seats. The prevailing tone of the panel work of the dining-room is green, charmingly relieved by bronze panelling on the walls. The ceiling is decorated with allegorical paintings representing the seasons, day and night, etc. The subjects of the paintings on the walls are the house in which the Crown Prince lives, the former palace and the cadet school in Plön, where the Crown Prince received his education. Adjoining the main dining-room there are forward and aft on each side extensions of this dining-room, forming, as it were, small dining-rooms. The walls in these smaller rooms contain landscape views of Potsdam, Sans Souci, Plön, Bonn and neigborhood. The large skylight, crowned with an arched cupola, is plastically decorated. A gallery surrounds the skylight, through the arches of which a view can be had from above into the dining-room.

A large vestibule on the promenade deck opens into the social hall above the dining-room, which shows at one end the life-size portrait of the German Crown Prince Wilhelm. The walls of this social hall are covered with fine silk brocade and with pictures of Prussian cities, as Berlin, Breslau, Königsberg, Magdeburg, Hanover, Cologne, Frankfort and Stettin. The social hall is provided with comfortable sofas and tempting easy chairs. A large Steinway Grand ministers to the musical wants of the passengers.

The library is decorated in Renaissance style. A number of writing desks, containing all necessary writing materials, are placed in this room. The seats are upholstered with mignonette colored velour de Genes. The table covers are decorated with embroidery and the curtains consist of gold silk. A soft Smyrna carpet covers the floor of both social hall and library. Large bookcases contain the best works of literature of all nations. The ceiling and the walls are decorated with paintings representing the muses.

The smoking-room shows in its style an adhesion to the Renaissance. The ceiling is carried by oak beams stained with blue, with panels in white relief. The walls show a white stucco frieze under the ceiling, below which they are decorated with paintings and gilt bordering. The wood work, as well as the tables, the sideboards and the great entrance which reaches to the cupola, consists of oak-wood stained blue. The table covers are of old blue silk and the seats of the chairs are in blue color. An enormous glass cupola furnishes light and ventilation. Along the walls the pictures consist of representations from the history of the Hohenzollerns in delft, besides which there is a large allegorical painting which carries out the Emperor's words: "Our future lies upon the water."

The "Kronprinz Wilhelm" contains quite a number of remarkable new technical improvements. An extensively ramified telephone service connects the captain from his room on the bridge with the chiefs of the various departments of the steamer. The refrigerating rooms for every species of provisions are most extensive and are kept at a certain temperature by ice machines. The kitchen shows numerous modern appliances that will cater to the most fastidious taste. Ascent to the crow's nest is not on the outside of the mast on a ladder, but inside of the mast, and the crow's nest itself is connected with the bridge by a speaking tube. All the clocks on the steamer, in the dining-rooms, in the vestibules, in the kitchen, etc., are electrically regulated from a central clock in the chart room. The "Kronprinz Wilhelm," as all other new vessels of the North German Lloyd, is provided with an apparatus for wireless telegraphy.

Examination for Draftsmen.

The Municipal Civil Service Commission of New York city, 346 Broadway, announces that there will be an examination

for the position of junior assistant architectural draftsman on Friday, October 18, 1901, at 10 A. M. The subjects of the examination are a technical paper, arithmetic, experience and handwriting.

For further particulars address F. G. Ireland, chief examiner; for applications apply to Lee Phillips, secretary.

Technical Publications.

"Engineering Studies—Part III.—English Stone Bridges." By C. E. Fowler. 16 17x10½-inch pages with eight illustrations. The Engineering News Publishing Company, New York. Price, 25 cents.

This pamphlet is uniform in make-up with Part II of the same series on "Roman Stone Arches," of which we published a notice in our issue No. 46, of last year. Excellent full-page half-tones illustrate some of the most famous stone arch bridges in the world. As in the former pamphlet, the descriptive notes relate to the architectural rather than the engineering features of the bridges—in fact, we take it, the object of this series is to place before American engineers illustrations of the finest works of this kind. By common consent such examples are needed to improve the architecture of our engineering works.

"The Indicator Handbook—Part II. The Indicator Diagram: Its Analysis and Calculation." By C. N. Pickworth. 132 5x7¼-inch pages with 148 illustrations. D. Van Nostrand Company, New York. Price, $1.50.

Part I of this book, which treats of the construction and application of the indicator, was favorably noticed in our issue for July 28, 1898. This companion volume fully meets the expectations based on the first volume. The construction of the theoretical expansion curve, both isothermal and adiabatic, is explained and the analysis of the diagram in order to determine from it the defects in the adjustment of various classes of valve gears is explained. Diagrams from compound engines and the method of combining them are given, and the subjects of diagrams from gas and oil engines and from air compressors and pumps, which are neglected in most books on this subject, are here treated with the fullness which their importance demands. The book is non-mathematical, and although of English origin, it is as acceptable to American as to English readers.

Y. M. C. A. Classes.

A series of night classes has just been started for the season by the educational department of the Young Men's Christian Association in this city, whose general offices are at 156 Fifth avenue, New York city. The association offers instruction at low cost in a great variety of subjects, among which are elementary and advanced mechanical drawing. Any young man of good moral character is eligible to membership, and many other features, such as gymnasiums, swimming pools, bowling alleys and camera clubs come with it. Work of the same sort is carried on all over the country.

It may be noted that for the past year the association has undertaken some rather aggressive work at Cleveland, Ohio, among machinists as well as railroad men and others. Up to last March seventeen "shop classes" had been formed for ten or twenty minutes' Bible study at noon, in which men of all creeds and of no creeds joined, with a resulting uplift, it is said, in the moral sentiments of the shops, friendliness between employers and employees, etc.

The "Technolexicon."

Regarding the paragraph we have printed in relation to the "Technolexicon" which is being prepared under the auspices of the "Verein Deutscher Ingenieure," the editor of the work referred to, Dr. Hubert Jansen, writes us that it is intended to include both the British and the American English terms which differ from each other, the language of the circular on this point being: "If it happens, as in some cases in North America, that there is a different universal expression from that used in England, the American expression would be included as well as the English, with a note such as 'America.'"

Those of our readers who may know of English technical terms which differ here and in Great Britain will be helping a good work by corresponding with Dr. Hubert Jansen, 49 Dorotheenstrasse, Berlin.

Personal.

I. I. Lyle, M. E., who has been connected with the home office of the Buffalo Forge Company for the past five years, is now manager of the New York branch at 39 and 41 Cortlandt street.

On October 7 we received a call from Mr. J. Neale Taylor, of Sydney, New South Wales, Australia. Mr. Taylor is a native Australian and a member of the firm of Taylor & Wearing, the leading foundrymen of Sydney. He has purchased a number of American tools and appliances for his antipodean foundry. He came from Sydney to San Francisco and goes from here to England, so that he will on reaching home have circled the globe.

Obituary.

John Leon Blankemeyer, president of the Toledo Foundry & Machine Company, died in Toledo, O., September 20, fifty-eight years old.

Henry W. Cramp, vice-president and treasurer of the William Cramp & Sons' Ship & Engine Building Company, died October 3, fifty years old. Mr. Cramp was the eldest son of Charles H. Cramp, president of the company. In his youth he served one year as an apprentice in a machine shop, but later he was entirely occupied with work connected with the financial and business interests of the company.

John Davis, a pioneer iron manufacturer, died in Cincinnati September 29, eighty years old. He came to this country from Wales in 1841. He was one of the founders of the Jefferson Furnace, Jackson County, Ohio, and was its manager for forty-two years, during which time it was never operated on Sunday. The business paid an average dividend of 40 per cent. a year, and all the stockholders became wealthy.

Pardon G. Armington died at Chatham, Mass., September 23, sixty-five years old. Mr. Armington lived in his boyhood at Lawrence, Mass., where he attended the high school and later learned the machinist's trade. In 1857 he went to work at Holyoke, but soon returned to Lawrence, where he began the manufacture of portable engines and later formed the well-known firm of Armington & Sims. He had been out of business for five years. In 1866 he was elected mayor of Lawrence.

Commercial Review.

NEW YORK, Monday, October 7.

One of the most interesting matters of news of the past week is the announcement that Westinghouse companies will found a new town at Stewart Station, Westmoreland county, Pa., where they will concentrate their foundries from Allegheny, Cleveland and the South Side Pittsburgh.

Frederic Eberhardt, of Gould & Eberhardt, Newark, N. J., has just returned from his European trip. It would be uncandid to say say that he found flattering prospects for the American tool business either in England or on the Continent. However, he has no idea of this country backing out of the world's market. We have entered there to stay, he holds, and he is of opinion that we shall be able to sell a good thing in the machine-tool line even in Europe. Mr. Eberhardt was impressed with the European sentiment toward this country, particularly as regards the tariff. Germany feels decidedly sore about America, because of our recent successful raid upon her markets and because our high duties keep out some of her products which she thinks we ought to have. The sentiment in favor of enacting her own proposed new tariff is very strong although there is some important opposition and the bill as it stands may fail at the last. Mr. Eberhardt believes that if we were to relax the rigor of our tariff before Germany took action upon hers it would have great influence in shaping her course less to our disadvantage. Such a modification is recommended for us by the people of Europe, not only for their own sake, but on the ground that we have

reached the point in our industrial career where a changed policy is expedient for ourselves. The tendency of this advice he assimilates to that of President McKinley's last speech.

In England Mr. Eberhardt found a sentiment entertained toward the Americans quite similar to that which must be held for the "Columbia"—a "forced admiration." Yet it was a true admiration and the sentiments of the nation toward us as a whole are very friendly. Great respect was shown for Mr. McKinley, and one man even referred to him as "our" President. Mr. Eberhardt visited Glasgow, but does not find that the commercial results of the exposition there are generally considered very successful. It seems to follow too closely after the one in Paris. Referring to the exhibits, he remarked that a very creditable one was that of Alfred Herbert, Ltd.

The Landis Tool Company, Waynesboro, Pa., manufacturers of universal and plain grinding machines, informs us that business generally has been very good with the concern, although foreign trade has taken away a part of their business which has had to be made up by increasing domestic orders. Their home trade has increased to such an extent that they are now shipping about as much machinery as they did previous to decline of foreign demand. This is an experience which is not limited to the Landis Tool Company, but which, we think, fairly characterizes the situation for the machine-tool trade in general.

The Hendey Machine Company, which was awarded the order for the 240 Lincoln milling machines for the Rock Island Arsenal shops probably long before the fact that it had been placed at all was generally known, has already constructed and shipped four or more carloads of them. The company having constructed this type of machine for the government is now taking occasion to place it on the general market.

The Wais-King Tool Company has been formed at Cincinnati for the manufacture of metal-working machinery, such as vertical boring mills, punches and shears. C. C. Wais, formerly of the Wais & Roos Punch & Shear Works, is one of the organizers. The temporary office is at 39 East Third street.

Sixty carloads of wooden doors are reported to have been shipped by a Pittsburgh firm for use in the new Manchester plant of the British Westinghouse Electric & Manufacturing Company, Ltd.

Work is progressing on extensions of the plant of the American Locomotive Works at Schenectady, N. Y. Among them are a 650x175-foot boiler shop for which the foundation has been laid, and a foundry of the same size.

The plant of the American Wood Working Machinery Company, Norwich, Conn., was sold at auction, October 2, to the bondholders' committee, consisting of Gen. Hiram Duryea of New York, C. L. Munson of Williamsport, Pa., and Frank H. Clement of Rochester, N. Y. The price paid was $40,000. The plant was formerly known as the C. B. Rogers Company's works. It is understood that the business will be reorganized.

Deputy Consul-General Simon W. Hanauer has sent us from Frankfort-on-Main, Germany, the following statement: "During the first half of the present year the value of machinery imported by Germany was 84,400,000 marks and her exports in that time aggregated 176,600,000 marks (a mark being 23¾ cents). Of machines imported England furnished 32.1 per cent. of the whole amount, consisting largely of spinning and weaving machines. Of the imported agricultural machines (weghing 15,079 metric tons) the United States supplied 78.7 per cent. Of German machines exported, 17.4 per cent. went to Russia. Austria-Hungary, Holland, Italy, France and Switzerland were also good customers. German machinery is shipped to many countries in Asia, Africa, Central and South America and to Australia."

In a French tariff decision it has been laid down that ordinary chains, or chains of the articulate system, are not to be considered as original parts of hoisting apparatus. They do not constitute, properly speaking, organs of the machines, but are intended to serve as intermediaries between the apparatus and the object to be lifted or carried. Yet, when they are imported adapted to the apparatus, or not being so adapted, if they are furnished with a mechanical piece such as a counterweight or a hook of large size, they become dutiable as part of the apparatus.

CHICAGO MACHINERY MARKET.

The representative of a large manufacturer of tools remarks that just now the salesmen of his company and of competitors are much more "chummy" than they have ever been before. This is not because of any "community of interests" among these manufacturers, but solely on account of the plethora of business. The sentiment is widely abroad that there is business enough for everybody and consequently there is an absence of that strenuous strife, engendering bitter feelings among competitors, that prevailed when orders were picked up with less facility. This increasing sociability is a barometer of trade in many lines.

So general and uniform are reports of excellent trade that differentiation is difficult. Factory construction work is active and for all the supplies that go into this construction there is brisk demand. Machine-shop activities also are rushing. Some proprietors are beginning to complain that they have undertaken too much work. People who want work done on the outside comment upon the difficulty of obtaining anything like dispatch. Representatives of almost all lines of machinists' supplies tell of an ideal state of demand, the criticism in some instances being that the inquiry is excessive. A very few relate the opposite experience.

It must not be understood that trade is phenomenal, but it seems fully up to the measure of producing capacity in shop fittings with a somewhat less activity in shop supplies. For the rougher kinds of material there is great scarcity. A user of special size angles placed an order last April with a prominent Pittsburgh manufacturer, but the date of shipment is not yet named. There is some slight scarcity of twist drills, while bolts are very scarce and are advancing in price. Otherwise there does not seem to be any marked lack of supply for inside needs, save in raw material like tubes, sheets, etc., which are gaining in supply very slowly. There is brisk call for building trades tools, such as hammers, chisels, etc., both from city and country. Of the two, the country trade is perhaps the better.

The Reeves Pulley Company reports September trade the largest for any month in its history. Among orders lately received was the equipment of the plant of the Peters Lumber and Shingle Company, Benton Harbor, Mich. An interesting installation there included is what is perhaps the largest all-wood pulley ever built. It is 16 feet in diameter and 31 inches face, and is intended for flywheel and belt wheel combined. Wood pulleys of larger diameter have been built, but it is said they have had iron centers. This pulley weighs about seven tons.

Quotations.

NEW YORK, Monday, October 7.

Pennsylvania Foundry Pig Irons, Jersey City delivery:

No. 1 X	$15 15 @ $15 65
No. 2 X	14 65 @ 15 15
No. 2 plain	14 15 @ 14 65
Gray forge	13 50 @ 14 00

Alabama Pig, New York delivery:

No. 1 foundry, or soft	15 50 @ 15 75
No. 2 foundry, or soft	14 75 @ 15 00
No. 3 foundry	14 25 @ 14 50
Foundry forge, or No. 4	13 75 @ 14 00

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.68c. in carload lots; from store, 1.90 @ 1.95c. in small lots.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—1.90 @ 2.00c. from store.

Cold Rolled Steel Shafting—Base sizes—From store, 2.40 @ 2.50c.

Copper—Lake Superior ingot, 16⅝ @ 17c.; electrolytic, 16⅜ @ 16⅝c.; casting, 16 @ 16¼c.

Pig Lead—For wholesale lots, 4⅜c., with .02½ @ 05c. extra for carloads.

Spelter—4.25c., New York delivery.

Antimony—Cookson's, 10¼ @ 10⅜c.; Hallett's, 8½c.; U. S., Hungarian and Japanese, 8¼ @ 8½c.

Lard Oil—Prime City, 79 @ 80c. in jobbing lots.

Some of the Latest Reinecker Machine Tools.

Our readers know that, in connection with the Paris Exposition and otherwise we have illustrated from time to time machines built by J. E. Reinecker, of Chemnitz, Germany. We have in fact been glad of the opportunity of doing so, for the machines built by this concern are of such a character that we think all those who aim to keep themselves well informed on machine-tool matters should know of them. We present herewith engravings of some of the latest machines produced by the firm named, and by way of description and explanation cannot do better than to print the accompanying letter of Mr. Reinecker substantially as received. He writes:

Editor American Machinist:

With this letter I beg to hand you a series of photographs, some of which might be of interest to many of the readers of your most valuable paper.

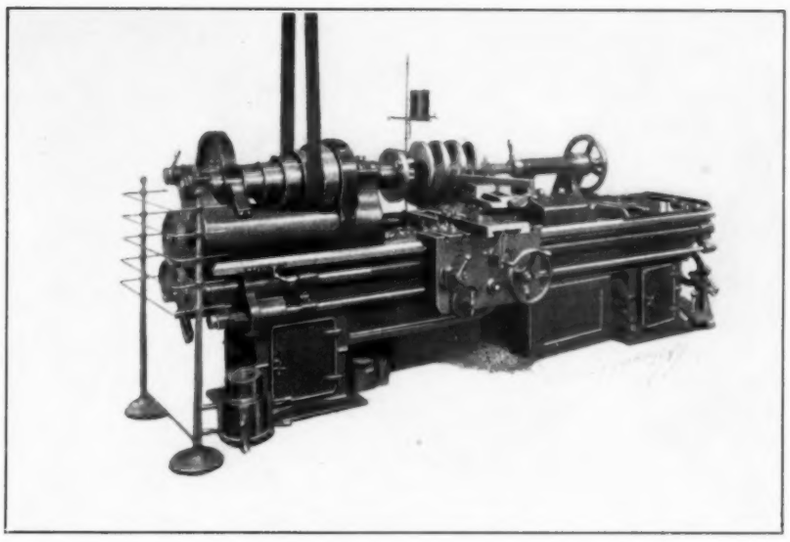


FIG. 1. REINECKER LATHE CUTTING A WORM.

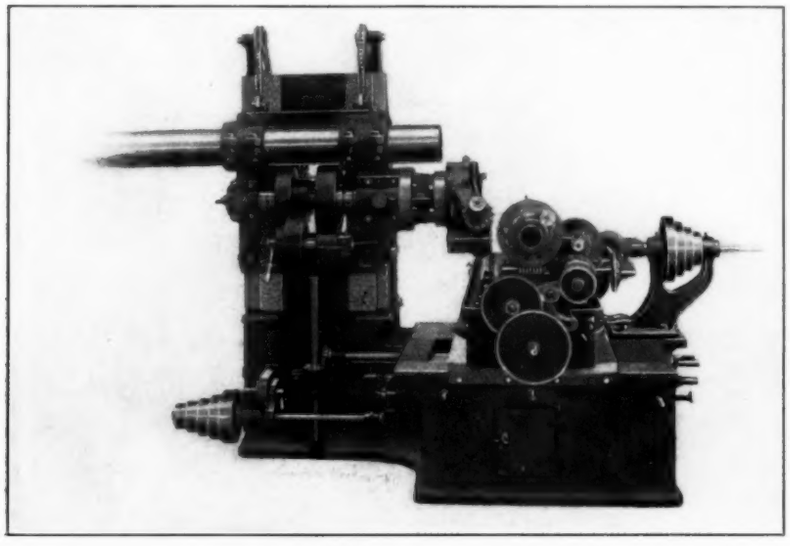


FIG. 2. REINECKER UNIVERSAL MILLER ARRANGED TO MILL A WORM.

Since I first brought out my new system of producing worm gears, I have had a great demand in machinery for making worm-gear hobs as well as worms. I succeeded in designing some new arrangements of good capacities, some of them turning out work of high quality at costs of production lower than ever before supposed possible.

While photograph (Fig. 1) shows one of my 20-inch swing lathes with gears arranged to cut coarse pitches, cutting a worm of 13 inches diameter, the photograph (Fig. 2) shows an arrangement of my universal milling machine No. 4 with worm milling attachment to cut worms up to 8 inches diameter. The worm cutter is mounted on a universal spindle head which can be swiveled to any angle of thread. The great advantage in milling worms instead of cutting them by a threading tool led to the construction of worm milling machines, which I build in two sizes. Photograph (Fig. 3) shows my No. 2 worm milling machine, having a capacity of 12 inches diameter, with work on it, a worm of tough machine steel 8 inches diameter 11 inches length, triple thread of 5⅜ inches pitch; time spent in roughing and finishing, 7¼ hours. My smaller machine, which is extensively used in the manufacture of worm-driven hoists, produces worms of about 2½ inches diameter, double thread, 2 inches pitch, at a rate of about one worm per hour. By these machines as well as by my worm-gear cutting machines, the costs of accurately cut worm gearing are reduced to such a low basis that worm gearing stands not higher in price than spur gearing, while the grade of perfection of the thus cut gears is the very highest, reducing the loss by friction to a minimum.

I beg to add photographs of No. 2 and

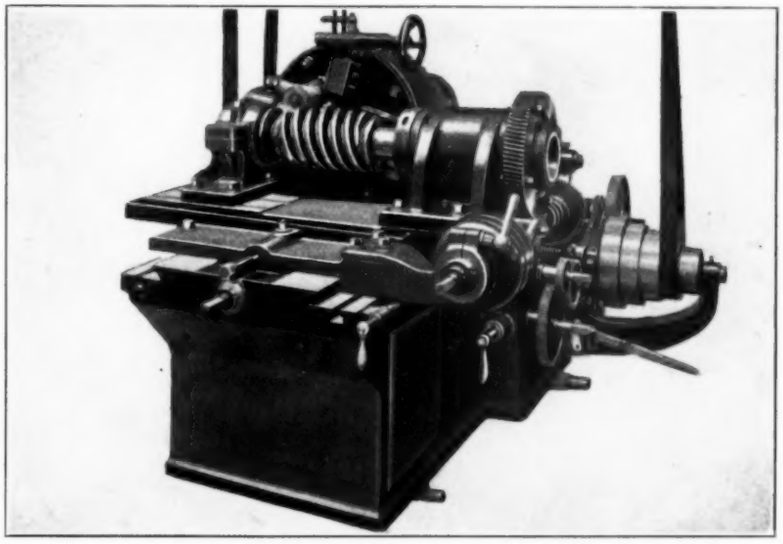


FIG. 3. WORM MILLING MACHINE.

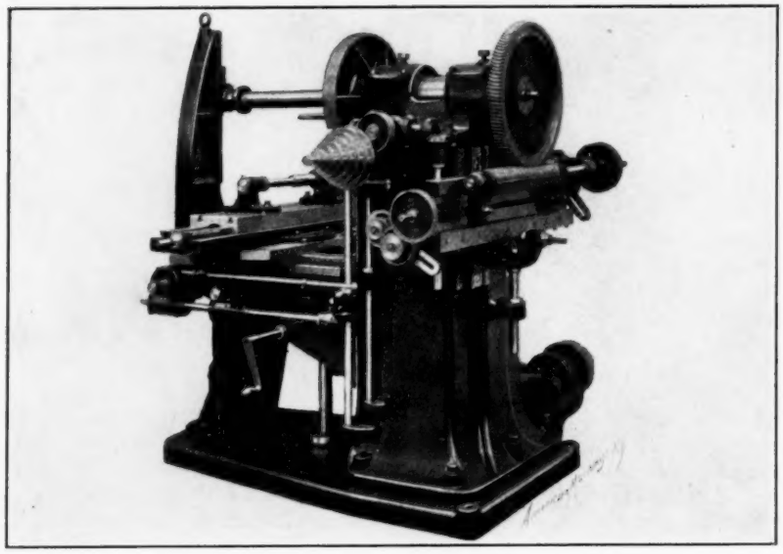


FIG. 4. UNIVERSAL, WORM, SPUR AND SPIRAL GEAR CUTTING MACHINE.

No. 3 universal worm-gear milling machine (Fig. 5) to cut worm gears to my method, by a conical hob, out of the solid, without any preceding stocking, also arranged to cut spur and spiral gears either in the old way, by relieved gear cutters as up to now generally in use, or by the new generating process, which lately is much used in our country, using a worm-shaped cutter to produce spur gears of any number of teeth, the cutter always producing the exact shape of tooth by automatically generating the same, much like Warner & Swasey's method, described in your esteemed paper many years ago.*

As quite a matter of course, also rack-cutting machines, both semi or full automatic, are much demanded of my firm, and I add a photograph of one of my No. 4 (Fig. 6) full automatic rack-cutting machines, which has capacity for racks up to 120 inches in length, 14 inches in width, coarsest pitch to be cut at one operation 3 inches, using three stocking cutters alongside finishing cutter.

Also I hand you photograph (Fig. 7) relating to worm-gear hob making. The photograph shows a hob of 13 inches diameter being grooved on my No. 3 universal milling machine; a pretty hard test of the machine, though it stands it easily, while photograph (Fig. 8) shows my biggest relieving machine No. 5 swinging hobs up to 18 inches diameter.

Further I enclose photographs of some big milling machines. While the machine (Fig. 9) is one of the often-demanded sizes—120 inches length of travel—the machines (Figs. 10 and 11) are of somewhat extraordinary sizes. The machine (Fig. 10) has a table 260x54 inches, automatic travel 240 inches, and is constructed for boring bearings and other holes and for milling sliding and other surfaces on compressor frames, steam-engine frames and similar work. It is a combined boring and horizontal and vertical milling machine. Also the vertical spindle has boring feed (not shown in photograph), also automatic transverse milling feed.

The machine (Fig. 11) has a table 204x74 inches, automatic travel 200 inches, and takes pieces up to 106x50 inches between housings and under the cross rails. The vertical spindles have automatic transverse motion. This machine is designed to mill dynamo housings and other electric machinery.

[*The machines here shown are an improved form of a similar machine very fully illustrated and described at page 557, last year.—Ed.]

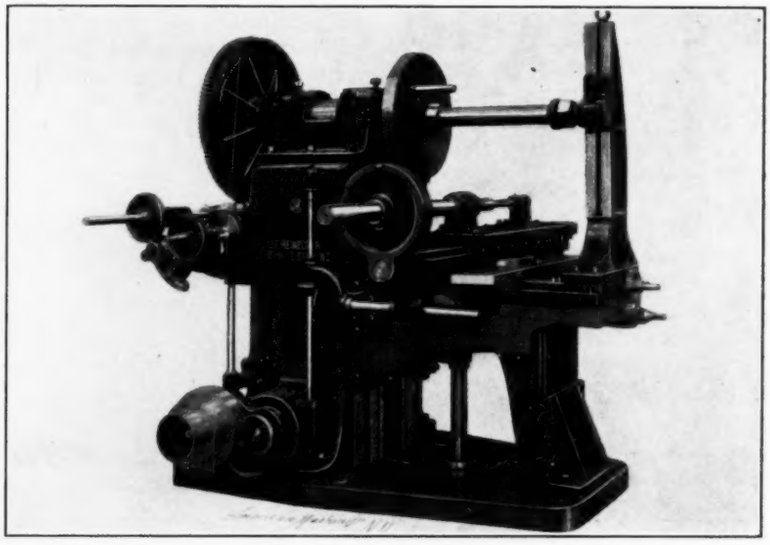


FIG. 5. UNIVERSAL, WORM, SPUR AND SPIRAL GEAR MILLING MACHINE.

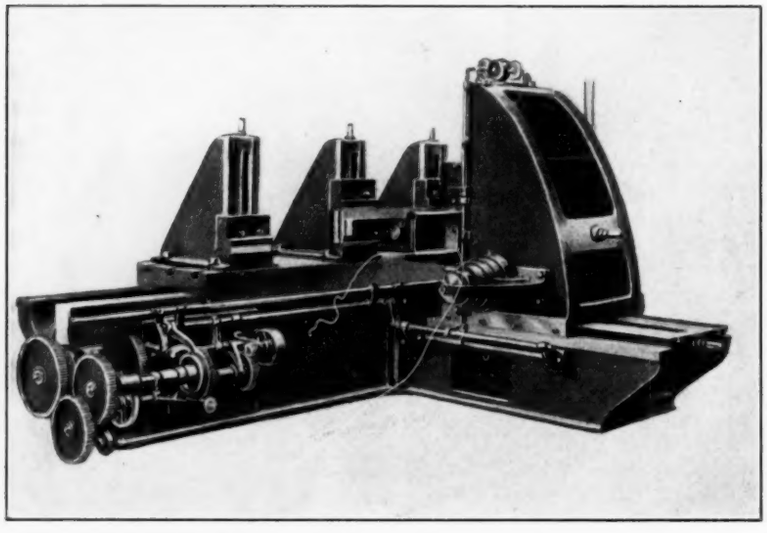


FIG. 6. AUTOMATIC RACK CUTTING MACHINE.

Origin of Machine Tools.

It is well known that machine tools in anything like their present form are a comparatively modern product. Many of their essential features, however, are much older—so old, in fact, that their origin is a matter upon which

we have very little information. A writer in the "Deutsche Metall-Industrie Zeitung" attempts to throw some light upon the subject by tracing the principles involved back to the dawn of history. Machines for cutting, grinding, turning, polishing or hammering solid or plastic bodies have been used from very early times. The potter's wheel, which is properly a machine tool, was employed in ancient Egypt. It was at first a simple disk turned by hand, but later a flywheel operated by foot power was added. The early existence of another machine tool has been proved by the discovery by Prof. Petrie, of London University, in Old Thebes, of a stone circular saw estimated at 2,600 years old.

The antiquity of the lathe is proved by the remains in Egypt and Assyria of objects which show its use, and through references to it by the Greek historian Herodotus (born about 500 B. C.) as if it were something well known in his day. The use of the grindstone is also evidenced by ancient tools which could hardly have been made without it. Glass-grinding lathes and appliances for grinding precious stones are also of early date. Pliny the elder and Strabo refer to the famous glass works of Alexandria and Sidon, where splendid cut ware and imitations of precious stones were manufactured.

The machine tools of ancient and mediæval times were probably made chiefly of wood and it is for the most part since the beginning of the nineteenth century that iron has been employed. It is believed that many modern machine tools are rediscoveries of ancient types which were lost in the Middle Ages. Like some of the modern trade unions the mediæval guilds of craftsmen were hostile to the introduction of machinery.

The writer points out that knife manufacture, aside from the grinding operations, was carried on chiefly by hand up to the invention of improved machinery by Smith in Sheffield in 1827. The first nail machine, he says, was built in Massachusetts in 1810. It turned out 100 nails a minute, but Europe was slow in adopting such machines. It is interesting to add that America has made further improvements in nail-making machines, which can perform wonders beside those of German build employed on the Continent. An account of an attempt that was being made to introduce them in competition with the German machines was published a year or so ago in the "American Machinist." We believe that many patents on nail-making machines were, in fact, taken out earlier than 1810, and doubtless some were constructed.

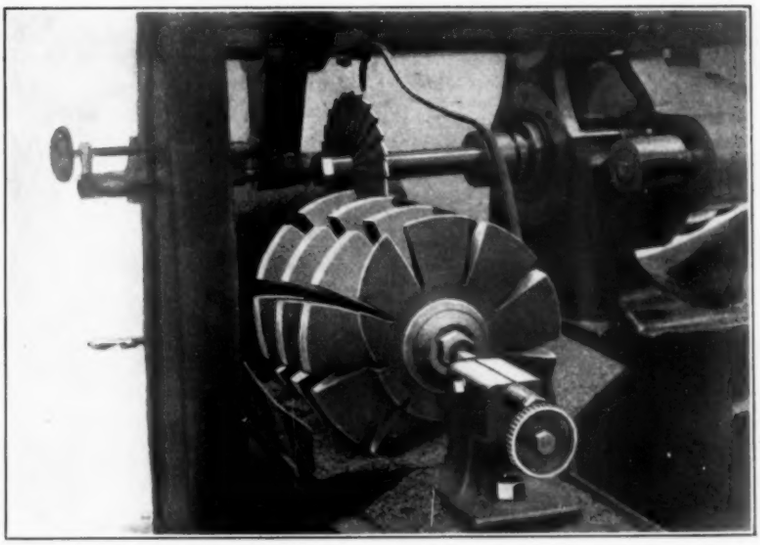


FIG. 7. GROOVING A HOB.

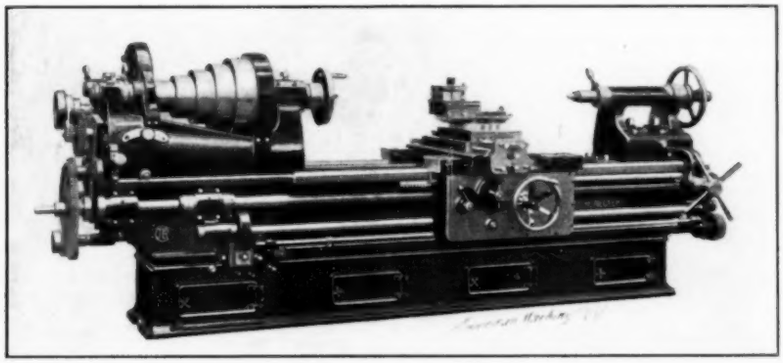


FIG. 8. LARGEST SIZE RELIEVING MACHINE FOR HOBS UP TO 18 INCHES DIAMETER.

For button manufacture about the only machinery used in 1820 was a rather simple press. In the wood-working line, as late as 1860, many large establishments depended upon hand work, and modern devices of wheelwrighting are largely a product of the last thirty years. As to brick making, the same methods for the most part were employed in 1825 as 3,000 years before in ancient Egypt.

The Disincrustation of Boilers.

United States Consul Benj. H. Ridgley sends from Malaga the following translation of an article recently published in "Revista Misura Metallurgica y de Ingeneria," of Madrid:

"The use of zinc to prevent the oxidation of the iron and the incrustation in

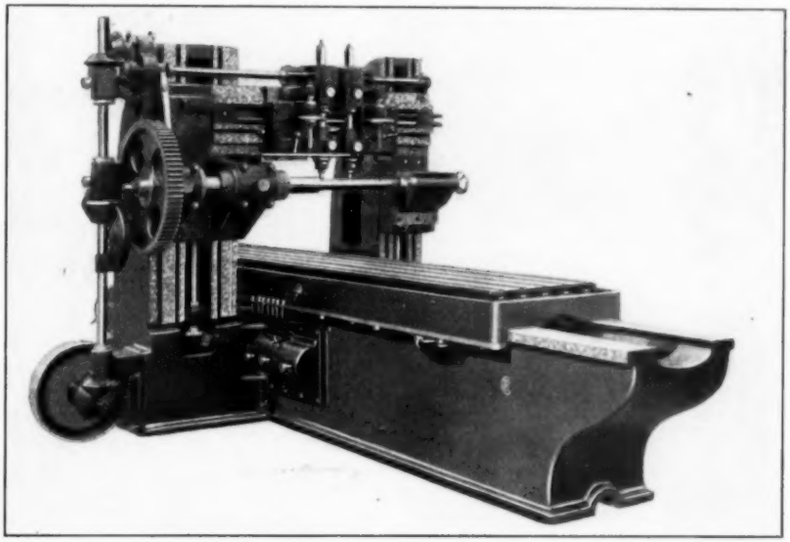


FIG. 9. A REINECKER MILLER.

steam boilers has greatly increased during recent years. Heretofore, zinc has been employed for this purpose only in the shape of raw pigs, but after many experiments made by the society of "Mines et Fonderies de Zinc de la Vieille Montagne," which have since been confirmed by the British Admiralty, by the national French marine, and many great maritime companies, it has been established that compressed laminated zinc made in the form of thick plates for application as an inside boiler lining is greatly superior to the old method. In fact, the galvanic current developed transforms the pig of raw zinc into a more porous substance, in which the metallic molecules are isolated one from the other by the corrosion which is quickly produced, resulting in this, that the intimate metallic current, which causes the generation of the electric current, is eliminated. Compressed laminated zinc, on the contrary, resists the spongy internal corrosion, as it corrodes only on the surface, thus being very slowly consumed and being capable of conducting the current as long as a metallic nucleus remains. The application of the laminated plates is very simple. They are applied to the walls of the boilers by means of strips and are so distributed that the galvanic action is exercised in an even way, when possible, over the entire surface of the iron. When oxidation is produced in any part of the boiler, it is because the nearest zinc plate is too far away. By this employment of pressed zinc the incrustation of the boilers is avoided, and at small cost."

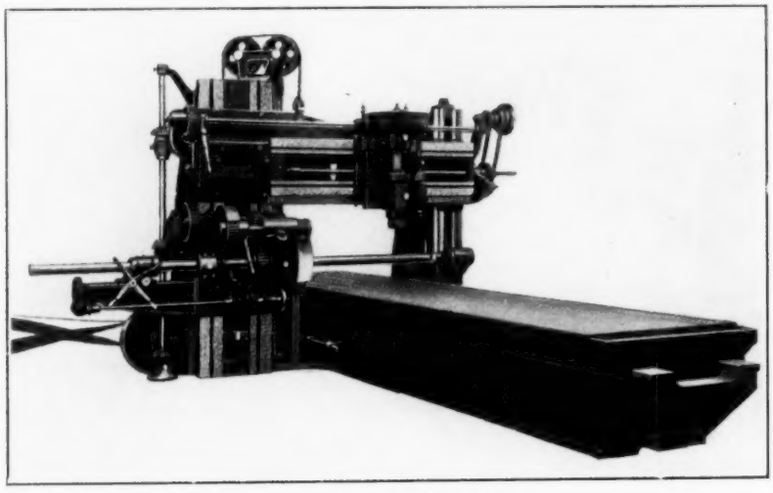


FIG. 10. A REINECKER MILLER.

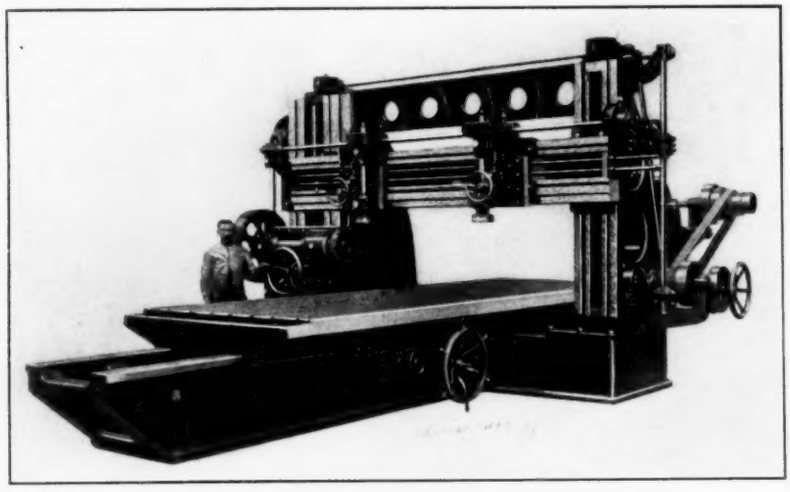


FIG. 11. A REINECKER MILLER.

Tube Forming Dies—II.

BY B. J. DOUGHERTY.

Following up the account which I gave at page 735 of some tube-forming tools, another method of forming sheet metal into tubular shapes is to use two dies. One is a simple push-through die. The opening in this die is of the correct taper for the tube to be made. The width at the center lengthwise equals the diameter of the model at the same center. The opening or slot should be longer than the model, say ¼ inch, for the reason that has been mentioned in the previous article on taper tubes, and for still another reason: the forming punch should always be longer than the metal or blank which it has to form. It is an unwritten law in this line of work to always have a margin, and it is expected of the workman that he will reserve his close work for the places where it is absolutely necessary. If this opening in the die was exactly the length of the model, the punch would necessarily be the same; then, of course, the metal would have to form around the extreme ends, and, as these edges are liable to get rounded or dented by the rough handling they get, any mark on the edges would certainly appear on the work produced.

The punch and die for the second operation are made as shown in the previous article for lap-joint tubes, the punch exactly so, but the die has an addition—that is, two pieces are put on, as shown in Fig. 1. These side pieces serve a double purpose: they act as gages to place the blank or U, in this case inverted, and also to prevent it from bulging outward when being formed. Sometimes the die is made in this shape of a single piece, but this depends upon circumstances. A mandrel is used with these dies, be they metal of heavy gage or light. One blow only is required for tin or light gages, but two blows are necessary if heavy gages are used, because more power is required to force the metal around the bottom of the die. After the first blow a slight bulge appears at the spot where the punch and die meet; the second blow removes this, but the blank must be turned around a little in the die.

The method of operating these tools is to place the mandrel in the die, letting it lie on the bottom; the blank is then inserted, the lips of the U downward, as shown at *B*, Fig. 2. When the punch descends upon the blank it forces the edges around the bottom of the die, if it is thin metal, and it easily finds its way under the mandrel until the edges meet in the center and the circle is completed (*C*, Fig. 2). If the metal is of heavy gage it is another story. The edges or flat parts of the blank do not yield so readily, but jam the mandrel between them and spoil everything. There is a remedy for this. Just at what gage of metal the dividing line is to distinguish between heavy and light in this connection has never been determined, because a good deal depends on the diameter of the tube to be formed. The diemaker has to be practical and full of resource, so when he runs up against a jam like this he simply suspends the mandrel above the die, as at *A*, Fig. 2. This accomplishes the end desired. The die then has to be placed in the press with the wide end of the taper at the back, or exactly in the position the reverse of what it would otherwise have been. The mandrel is tongued into a stud, a pin is passed through them, as shown, the pin is driven tight in the tongue or joint of the mandrel and the hole through which the pin passes in

the stud is slotted to allow some up and down motion. A spring is put under the mandrel close up to the stud; this keeps the mandrel above the die. The slotted hole, together with the hinge movement of the joint pin, allows the mandrel to rise and fall freely with the punch. When the punch descends upon the blank the edges of the U are forced somewhat nearer the center of the die, and they thus get a sufficient start of the mandrel to enable it to pass entirely under just as the stroke is completed. This method is used for such work as garden spades, forks, stove shovels, etc., and gives us very effective and durable tools. In light or small work, when the mandrel simply lies in the die, such work as oil-can spouts, parts of funnels, etc., can be produced rapidly. The advantage these tools have over the ones previously described is that they can be used for either heavy or light work.

There is still another way of forming parallel tubes only, in which the mandrel is dispensed with—a very valuable feature—but on work where the stock is heavy only, say, about 16 or 14 gage. Two dies also are used in this case, either a push-through die, or, where this is impossible when, owing to the length of the blank, the opening in the bed of the press would not let it pass through, or in cases when the tubular part is only one section of the article to be made, then the U-ing or burring die and punch are made as shown at *A*, Fig. 3.

The "rolling-over" die is made as at *B*, Fig. 3. The action of the metal in dies made on this principle is peculiar. Someone might say that it is on the wiring principle. But no; it is entirely different; the edges of the "U" or blank never pass the center of the die, but they meet there in a V-shape, when the punch forces it into the die (see *C*, Fig. 3). As the punch descends still lower the edges butt hard against each other; the metal must go somewhere, so it takes the form of *D*. As the punch reaches the lowest point the metal is fully expanded and completes the circle, making a perfect tube. It might occur to someone that the metal is as likely to collapse as to expand; but outwards is the easiest way, and the metal always follows the line of least resistance. The width of the blank must be very accurate, and it can be only determined by actual trial in the dies. The metal upsets a little in this process, so there is no kind of figuring which would come out right without trying. When the width of the blank has been found, the blanks must be cut out with a die to insure accuracy. If the blank is of sufficient width to complete the circle exactly, without leaving any mark on it where the punch meets the die, it will be perfectly round, but the joint of the tube will be a little open. If it is desired that the joint shall be very close, the blank should be made a little wider, but this will leave a slight mark along the line where the punch meets the die. This mark will be so slight, however, as to be of no consequence for practical work, and the edges of the joint will cling together so that if forced apart they will spring back close. I merely mention this to show how a closed or an open joint may be obtained as desired. This feature of being able to form tubular shapes without a mandrel is, as I mentioned before, of extraordinary value. There are instances in which it would be impossible to withdraw the mandrel from the work, and unless this method could be used without a mandrel it would compel more operations in the making. To prove this I send a section of a tube cut from the middle of a handle, the handle itself complete, also a handle ready for this operation just described (see half-tone, Fig. 4). These last dies are hardened of course. I have refrained from mentioning this hitherto. I have also omitted some of the dieblocks or beds, some screws, gages, etc., leaving these for the reader to determine. It is the principle on which the dies are made that is the important feature. Mere small details of construction can be, and are, safely left, in this line of work at least, to the mechanic.

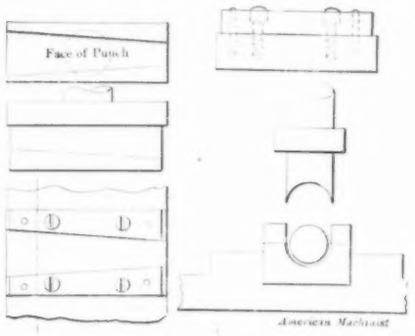


FIG. 1. DIE FOR BENDING TUBES.

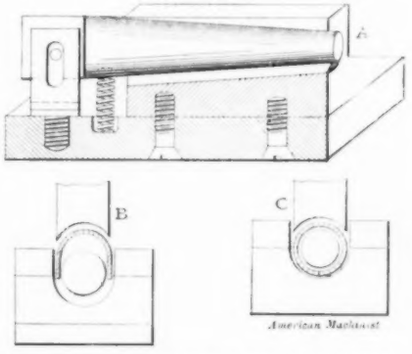


FIG. 2. BENDING TUBES WITH A MANDREL.

The rolling-over die for this job was shaped out as shown, to 1 inch diameter, allowing a little for reaming. The die and plunger were then fitted together nicely, put in the press and the slide brought down tight at the lowest point of the stroke, thus clamping them together, which made an ideal way to hold them for reaming, and they were then reamed in that position.

Echoes From the Oil Country.

HUNTING TROUBLE.

It often happens that a mechanic who is doing outside work for a jobbing shop is sent to repair machines that are new to him and where he has no knowledge of the theory on which they are built, and again conditions may have arisen that are beyond his control, but which he must discover to explain the working or lack of working of what he is sent to fix. In such cases his powers of observation and of deduction are apt to be pretty well tested, and if to this is added the unfriendliness of the man in charge, the situation is about as bad as it can be.

A small engine was used to run a dynamo used in lighting a refinery. This was in the days when electric lighting was a rarity, and a dynamo a curiosity whose action was often not understood by those who ran it, while to the rest of us the talk of circuits and grounds, shunts and induction, volts and amperes was mystifying and often stupefying. The governor of this engine, not regulating close enough, was sent in for repairs. These consisted in supplying sufficient washers above and below the spool to take up all slack. The governor was one of the common throttling type with a lever and ball for changing the speed.

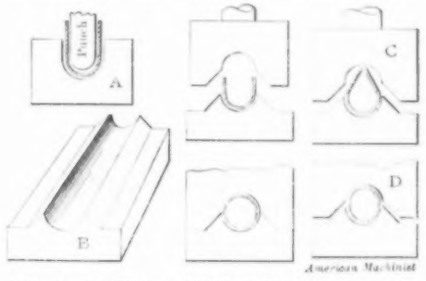


FIG. 3. BENDING TUBES WITHOUT A MANDREL.

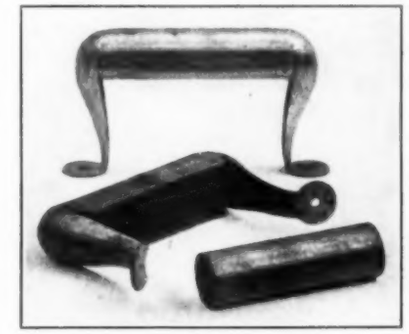


FIG. 4. SAMPLE OF TUBE BEFORE AND AFTER CLOSING.

In due time word was received that the governor was no good, and I went up. Anyone who had never gone out to such a place on such an errand might be surprised to learn how long some people will keep a thing without complaining, although "it never worked right from the time it was fixed."

I once had a man refuse to keep and pay for an engine after running it for some time, because he dropped a monkey-wrench and it caught between the flywheel and the foundation and bent the shaft. Before that he had been delighted with it, but he suddenly had his eyes opened to the fact that it had never been right. "Didn't like to say anything at first, being a friend of the shop, etc., but could see plainly it would never do the work to his satisfaction."

When I got to the refinery I heard the usual tale of how the trouble dated back to the repairs. Just why taking up the slack in that governor should make the engine get progressively weaker I couldn't understand. In talking with the man in charge, who, by the way, gave me to understand that things went as he said around there, I found nothing seemed to suit him. I also found out that a young man I had discharged was related to him. I had looked the engine over very carefully by this time, and could find nothing wrong. I could understand a very broad hint that it would be necessary to put the aforesaid young man to work again before the machinery we repaired would work right. Having always hired on the basis of the value of the individual who was to do the work, I was blind to the hint, but fully alive to the situation. If that engine had ever run that dynamo I determined it should again.

There was no trouble with the engine as far as knock or anything of that kind went, it seemed to be weak and would not keep the lights up bright. I changed all the washers to the top of the spool, so as to get more lift to the governor valve; ran the ball to the end of the lever and tied on some extra weight and started. This, you understand, after various trials and slow-downs.

I had noticed one thing that puzzled me. It seemed to take quite a time to throw on the different circuits; there were three. We started with all off and with the brushes off the commutator. After getting up to speed, the brushes would be let down and one after another of the circuits thrown in, and the electrician would keep going the rounds of the machine and connections with each attempt I made. I had always supposed they could run themselves with very little attention, as the few I had seen got very little. This one seemed different—just then at least.

On this last attempt, as I had the governor weighted down, I was regulating the speed with the throttle as the load was being thrown on, and I was pleased to see that the speed kept up when the lights were all on, and that it held there as minute after minute passed. My friend was shifting uneasily back and forth between the dynamo, which was sparking badly, and the switchboard, while I was watching over the engine with an oil can. Suddenly the engine began to speed up, and the electrician stepped quickly away from the switchboard while I sprang for the throttle. I found I had to remove all the extra weight and push the ball nearly as far in as it would go to have the governor hold. I asked him what caused the difference, when he denied being within several feet of the switchboard, and declared he had not touched anything. I could not prove that he had, but I called in the man who had charge of the refinery to let him see that things were running satisfactorily, and gave my friend to understand that if that governor gave any more trouble I would have a personal interview with the superintendent of the company and have him present when I fixed it. I have since thought that perhaps a ground helped to make load, and the engine was running strong enough to cause heating of the dynamo from overload to such an extent as to cause alarm, and so it was thrown off, with the results as noted.

It is no uncommon thing to have to hunt for trouble outside of your own work. One of the jobs greatly disliked is repairing the acid pumps. These pumps are used to pump sulphuric acid, large quantities of which are used around the refineries for treating the oil. The fumes of the acid make a man think he has caught a hard cold, while the acid puts holes in shoes and clothing, and if it is the new acid it eats into the flesh, while the spent acid leaves a clinging stink that anyone ever around an oil refinery will be slow to forget.

On one occasion I was called out when the regular acid handler was sick. After examination I declared that the line was stopped up. That meant digging up a couple of hundred feet, and the other fellow declared the line was all right, that the acid wouldn't freeze, and so forth. Certainly the acid at the pump wasn't frozen. It was in January. I went over the pump again and found nothing, and I finally suggested turning the steam into the line and seeing if it would blow through. This was agreed to and I made the connections. The steam went about 100 feet and stopped, we found that was as far as the line drained toward the pump, and so the line had to be dug up. That steam cost them a new line that far, and I added to my stock of knowledge.

The acid is handled by the carload in common iron tanks, and is pumped through iron pipe with iron pumps, and it seems to have no bad action; this is true of the spent acid also. The spent acid is the acid after it has been added to the oil and agitated and has taken up all the dirt or free carbon in the oil. It is then drawn out and sent back to the acid works and purified. The acid works furnishes the man who sees to the loading and unloading at the refineries, the refineries really paying so much a pound for the use of the acid, getting the new in their tank and delivering the spent in a tank furnished by the refinery. Acid Pete was a well-known character at all the refineries, and it was only when someone else was doing his work that such things as I did were allowed. With a little water in the acid it eats up iron very rapidly. Indeed, Pete claimed that with one pail of water in a tank of acid the acid would eat the tank up. When working around a tank of the new acid a pail of hot water was kept at hand, and the hand was thrust into this if any of the acid got on it. I enlarged a hole in the bottom of a tank once and I had quite a number of little burns. As they healed up the scabs pulled out like slivers, showing that the acid had penetrated until diluted by the juices of the system, so that it was too weak to eat further. You cannot wonder we did not hustle much to get Acid Pete's work, although it was good pay.

To try to run a pump against a closed line was a common thing, and one it was hard to guard against; the pipes in the refineries are so numerous and often go under ground. The old refineries were built up gradually by additions without a general system, and valves would be found everywhere. To help things along a great many gate valves are used, and some open one way and some another. In the new ones an arrow might be cast on the hand-wheel, showing which way to open, but in many cases a loose wrench would be used, so a stranger couldn't tell whether a valve was open or shut or where it led to.

On some of these occasions warm arguments would be indulged in as to whether lines were open or not, and on one trip I had to take off the top of the valve covers of a tar pump and treat a chap to a bath of tar to convince him that the pump would throw if it had any place to throw to. I got a face full in doing it, but he got it all over, so I felt satisfied, especially as it made him find another valve which someone had closed.

W. OSBORNE.

The Strength of Flat Plates.

BY ALBERT E. GUY.

At page 828 is an article contributed by Mr. Geo. E. Barrett, on "Thickness of Plates Encastré." From its beginning this article attracts the attention and lends itself to criticism. Effectively the following sub-title is met with: "Pressure on Plates Encastré Marichal." Now, the French word "encastré," meaning cast with, fixed, firmly held, is used sparingly in text books and is not understood by everybody; as for the word "marichal," it it is neither French nor English, and we must ask the author to explain it.

The method exposed is pleasing by its simplicity, but, unfortunately, judging by the formulas given in the article, it is erroneous. It is not apparently based on any given theory, but the resultant formulas for round and square plates, differing only in the numerical value of the coefficients from those shown in text books, must evidently have impressed the orig-

inator that his approximative method was correct, and led him further to the other applications of it.

A plate under pressure is like a beam subjected to flexure, but, because of its shape, its case is much more complicated. One general formula can express the strength of a flat plate of any shape, but it would be impossible to determine as generally the strength of a plate enclosed between ribs, because such a plate forms with the adjacent ribs a beam of varying section, which requires a totally different mode of calculation from that of the simple plate.

The formulas in general use for flat plates are due to Grashof, and are given, together with the original theory, in his work, "Theorie der Elasticitat und Festigkeit." They are to be found more or less complete in text and hand books. In more recent works Grashof's theory has been analyzed anew, and the authors have reached the same conclusions, with the exception of the value of the numerical coefficients, which are derived from that of the coefficient of lateral contraction, the main values attributed to this latter varying from one-third to one-fourth, depending, of course, on the kind of material used.

Let us compare Mr. Barrett's formulas with those of Grashof.

d = diameter of plate.
m = side of square.
p and v = respectively long and short side of rectangle.
t = thickness of plate.
T = tensile stress on material per square inch.
P = pressure per square inch on plate.

Mr. Barrett's equation (9):	Grashof's formula: Coefficient = 1/3	Coefficient = 1/4
$T=\frac{Pd^2}{8t^2}$	$T_1=\frac{Pd^2}{6t^2}$	$T_2=\frac{45}{256}\times\frac{Pd^2}{t^2}$
when		
$T=5000$ lbs.	$T_1=6667$ lbs.	$T_2=7031$ lbs.

ROUND PLATES.

This shows that the tensile stress T, estimated to be 5,000 pounds per square inch by formula (9), is in reality from 6,667 to 7,031 pounds according to Grashof.

Mr. Barrett's equation (5):	Grashof's formula:
$T=\frac{Pm^2}{8t^2}$	$T_3=\frac{Pm^2}{4t^2}$
when $T=5000$ lbs.	$T_3=10000$ lbs.

SQUARE PLATES.

While for round plates the difference in the values of T is quite large, it is within the range of possibility; but the same cannot be said of Mr. Barrett's formula for square plates.

If we examine Mr. Barrett's formula (7) for rectangular plates we see that the allowable stress is:

$$T=\frac{Pp^2v}{8t^2}$$

and the thickness:

$$t=\sqrt{\frac{Pp^2v}{8T}}$$

the latter varying directly as the square root of the long side. By this is meant that of two rectangular plates of the same width, the longer one will have the greater thickness; and furthermore, using the privilege of supposing the side p infinitely long—just to test the formula—we see that in such a case the thickness would be infinite and would apply whether the width v be 1 inch, 10 inches or 100 inches. This formula is evidently wrong, for common sense indicates that the thickness of a rectangular plate, however long, cannot be very much greater than that of a square one whose side equals the width of the rectangle, and that there must be a limit in the length of a rectangular plate at which the thickness must remain constant independently of any further increase of the length. According to different authorities the thickness of a rectangular plate of indefinite length is twice that of a square plate whose side equals the width of the first plate.

In conclusion it may be said that Mr. Barrett's formulas for regular plates do not bear favorably comparison with the well-established formulas of Grashof, which have acquired the sanction of authorities on strength of materials, and have also been proved true by the experiments of Professor Bach. It is most certain that the method is valueless in its proposed application to cylinder covers between ribs.

In the annexed table are given formulas for calculating plates of regular shapes, held or supported and loaded in various ways. They represent about all the reliable information, on the subject of flat plates, that can be found in text books. These formulas do not deal with the breaking strength of the plates, but hold good only within the limits of elasticity, and, at that, not for all materials, but specially for those that are brittle, like cast-iron or brass. They do not apply to ribbed plates, and their application requires the greatest care in determining the exact conditions in which the plate is held. In fact, they would prove erroneous for any conditions other than those given in the table.

Let us now find the thickness of a cylinder wall, and that of its flat end, cast with it, a pressure of 150 pounds per square inch being applied inside the cylinder, whose diameter we may take as 24 inches, the allowable stress on the material being 2,000 pounds per square inch.

The thickness of the cylinder wall is, by formula (61):

$$t=\frac{p\,d}{2f}=\frac{150\times 24}{2\times 2000}=0.9''.$$

The thickness of the flat end, by formula (6), is:

$$t=0.408\,d\sqrt{\frac{p}{f}}=0.408\times 24\sqrt{\frac{150}{2000}}=2.68''$$

It is almost unnecessary to remark that very few designers would be satisfied with such sizes; the majority would use the thickness found for the wall also for the end, and would strongly rib this latter if it was required to keep it flat, or otherwise, would cone it or dish it, with or without ribs, according to circumstances, and they would secure a better casting by so doing.

We must be aware that in the present case, although the end is cast with the cylinder, and both are supposed to have the same resistance, the condition required by formula (6), viz.: that the plate be firmly held or fixed at the edge, is only partially fulfilled. The formula has been determined for the strict condition of a rigid support. Now, we can easily conceive that the strains developed in the plate are greatest at the edge and cause the cylinder wall—which, compared with the base, is relatively thin—to be distorted and consequently the support is not rigid; the curvature which the plate was to assume, due to its flexure, is modified, and the formula cannot be applied. This subject, which is very interesting for the mathematician, is well treated by Saint Venant in his translation, with notes, of Clebsch's "Theory of Elasticity." For the guidance of the practitioner there is, however, an axiom well kept in view by all designers: Avoid flat surfaces.

In the case just cited, if the end had been made spherical with a radius equal to the diameter of the cylinder, the thickness would have been only 0.9 inch, instead of 2.68 inches as required for the flat plate.

Grashof's formulas are given, as afore stated, by most hand and text books, but it is very discouraging to notice the fine display of ignorance which too many authors make—principally in practical work—in a concluding remark on the subject, and which is equivalent to this: The rules just exposed are due to Grashof; we have stated them simply in order to be up to date and to show you that we are aware of their existence, but really they are not used for cylinder covers, and consequently they are very likely based on incorrect hypothesis. Still, they err on the safe side, the thickness determined by them being excessive. Cylinder covers are generally dished or ribbed, and often dished and ribbed.

This is a strong case of sour grapes. Between a flat plate and one of the same size and strength, but properly ribbed, there is as much difference as between a beam or girder with a solid rectangular section—consequently heavy—and a built-up girder of the same strength, but lighter and more rigid. The advantages—economy of material, rigidity, etc.—are all on the side of the lighter plate or girder.

Besides, it is not sufficient to have the formulas at hand; it is necessary to know how and when to apply them. In another article I will analyze certain experiments

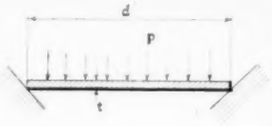
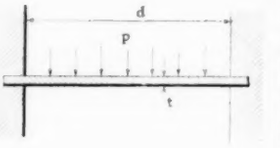
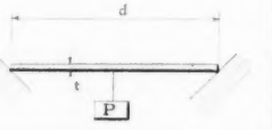
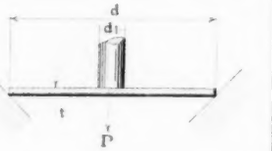
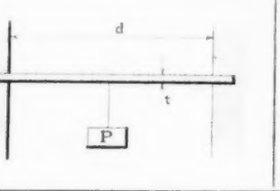
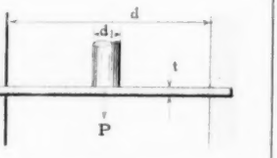
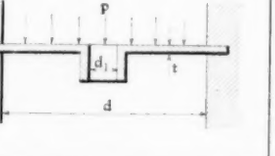
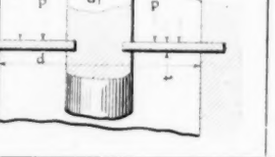
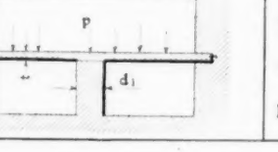
1 	$f = \frac{5}{24}\frac{d^2}{t^2}p = 0.2083\frac{d^2}{t^2}p$ (1) $t = d\sqrt{\frac{5}{24}\frac{p}{f}} = 0.4564\,d\sqrt{\frac{p}{f}}$ (2) $p = 4.8\,f\frac{t^2}{d^2}$ (3) $\Delta = \frac{1}{24}\frac{pd^4}{Et^3}$ (4)	Circular plate of diameter=d, supported at the edge and uniformly loaded. Δ = greatest deflection at centre of plate.
2 	$f = \frac{1}{6}\frac{d^2}{t^2}p = 0.1667\frac{d^2}{t^2}p$ (5) $t = d\sqrt{\frac{p}{6f}} = 0.408\,d\sqrt{\frac{p}{f}}$ (6) $p = 6\,f\frac{t^2}{d^2}$ (7) $\Delta = \frac{1}{96}\frac{pd^4}{Et^3}$ (8)	Circular plate of diameter=d, fixed at the edge and uniformly loaded. Δ = greatest deflection at centre of plate.
3 	$f = \infty$ at centre $\Delta = 0.1375\frac{Pd^2}{Et^3}$ (9)	Circular plate of diameter=d, supported at the edge and loaded at center. Conditions impossible to realize in practice, as the load cannot be applied on one point which has no dimensions, but must be distributed on a certain surface, however small.
4 	$f = \frac{P}{\pi t^2}\left(\frac{4}{3}\log.nat.\frac{d}{d_1}+1\right) = K\frac{P}{t^2}$ (10) $t = K_1\sqrt{\frac{P}{f}}$ (11) $P = K_2\,ft^2$ (12) $\Delta = \frac{5}{128\pi}\frac{Pd^2}{Et^3} = 0.1526\frac{Pd^2}{Et^3}$ (13)	Circular plate of diameter=d, supported at the edge and loaded at centre on a circle of dia.=d_1 When $\frac{d}{d_1}$ = 10 | 20 | 30 | 40 | 50 K = 1.295 | 1.588 | 1.76 | 1.884 | 1.98 K_1 = 1.138 | 1.266 | 1.327 | 1.373 | 1.407 K_2 = 7.721 | 6.3 | 5.68 | 5.305 | 5.063
5 	at center $f = \infty$ at the edge $f = 0.43\frac{P}{t^2}$ (14) $t = 0.655\sqrt{\frac{P}{f}}$ (15) $P = 2.33\,ft^2$ (16) $\Delta = \frac{55}{1000}\frac{Pd^2}{Et^3}$ (17)	Circular plate of dia=d, fixed at the edge and loaded at centre. Condition impossible to realize in practice as the load cannot be applied on one point-which has no dimensions-but must be distributed on a certain surface, however small. This case is consequently of no practical use
6 	$f = \frac{P}{\pi t^2}\left(\frac{4}{3}\log.nat.\frac{d}{d_1}\right) = K\frac{P}{t^2}$ (18) $t = K_1\sqrt{\frac{P}{f}}$ (19) $P = K_2\,ft.^2$ (20) $\Delta = \frac{3}{8\pi}\frac{Pd^2}{Et^3} = 0.1194\frac{Pd^2}{Et^3}$ (21)	Circular plate of diameter=d, fixed at the edge at centre on a circular of dia.=d_1 This case is practical, the thickness is independent of the dia. of the plate. When $\frac{d}{d_1}$ = 10 | 20 | 30 | 40 | 50 K = 0.977 | 1.27 | 1.411 | 1.566 | 1.66 K_1 = 0.988 | 1.127 | 1.2 | 1.251 | 1.289 K_2 = 1.024 | 0.7873 | 0.6944 | 0.639 | 0.6019
7 	$f = K\frac{d^2}{t^2}p$ (22) $t = K_1\,d\sqrt{\frac{p}{f}}$ (23) $p = K_2\frac{ft^2}{d^2}$ (24)	Circular plate of dia.=d, fixed at the edge and uniformly loaded, having a concentric opening of dia.=d_1 enclosed by a ring cast to the plate. Case similar to that of a cylinder bottom with a stuffing box When $\frac{d_1}{d}$ = 0.1 | 0.2 | 0.4 K = 0.1618 | 0.1484 | 0.10525 K_1 = 0.4022 | 0.3861 | 0.3244 K_2 = 6.182 | 6.708 | 9.502
8 	$f = K\frac{d^2}{t^2}p$ (25) $t = K_1\,d\sqrt{\frac{p}{f}}$ (26) $p = K_2\frac{ft^2}{d^2}$ (27)	Flat ring of outside dia.=d, inside dia=d, fixed at both edges and uniformly loaded When $\frac{d_1}{d}$ = 0.3 | 0.4 | 0.5 K = 0.07595 | 0.05071 | 0.03292 K_1 = 0.2756 | 0.2252 | 0.1815 K_2 = 13.165 | 19.72 | 30.36
9 	$f = \frac{45}{128}\cdot\frac{pd^2}{4t^2}\left(\log.nat.\frac{d}{d_1}\cdot\frac{d_1^2}{d^2}+1\right)$ (28) $f = K\,p\frac{d^2}{t^2}$ (29) $t = K_1\,d\sqrt{\frac{p}{f}}$ (30) $p = K_2\frac{ft^2}{d^2}$ (31)	Circular plate of dia.=d, fixed at the edge and supported at centre on a circle of dia.=d_1 and uniformly loaded When $\frac{d_1}{d}$=0.1 | 0.2 | 0.3 | 0.4 | 0.5 K = 0.1153 | 0.1719 | 0.20311 | 0.2223 | 0.234 K_1=0.3396 | 0.4146 | 0.4507 | 0.4714 | 0.4815 K_2=8.67 | 5.818 | 4.923 | 4.5 | 4.313

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FIG. I. THE STRENGTH OF ROUND PLATES.

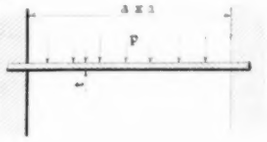
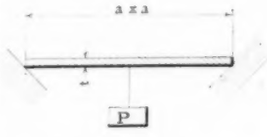
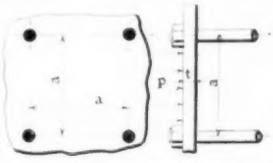
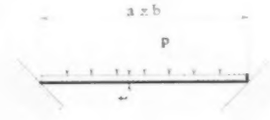
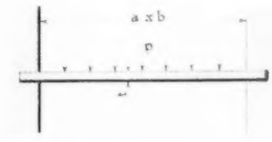
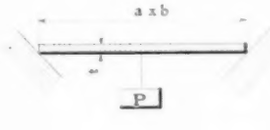
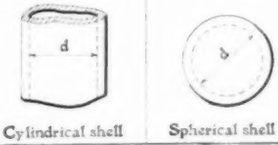
10		$f = 0.23 \frac{a^2}{t^2} p$ (32) $t = 0.4796\, a \sqrt{\frac{p}{f}}$ (33) $p = 4.347\, f \frac{t^2}{a^2}$ (34) $\Delta = 0.0475 \frac{a^4}{t^3} \frac{p}{E}$ (35)	Square plate of side=a, supported at the edges and uniformly loaded. These formulæ are due to Navier
11		$f = 0.25 \frac{a^2}{t^2} p$ (36) $t = \frac{a}{2} \sqrt{\frac{p}{f}}$ (37) $p = \frac{4 f t^2}{a^2}$ (38) $\Delta = \frac{1}{64} \frac{p a^4}{t^3}$ (39)	Square plate of side=a, fixed at the edges and uniformly loaded. These formulæ are due to Grashof and are said by many authorities to be only approximative.
12		$f = 0.57 \frac{P}{t^2}$ (40) $t = 0.755 \sqrt{\frac{P}{f}}$ (41) $P = 1.754\ ft^2$ (42) $\Delta = 0.115 \frac{a^2 P}{E t^3}$ (43)	Square plate of side=a, supported at the edges and loaded at centre. Formulæ due to Navier. The load, in reality, is applied on a small surface. Here, as in case 5, it is seen that the thickness and the stress are not dependent upon the dimensions of the plate.
13		$f = \frac{2}{9} \frac{a^2}{t^2} p$ (44) $t = 0.4174\, a \sqrt{\frac{p}{f}}$ (45) $p = 4.5 \frac{ft^2}{a^2}$ (46) $\Delta = \frac{1}{36} \frac{p a^4}{E t^3}$ (47)	Portion of plate supported by four stays, forming the corners of a square of side=a, uniformly loaded
14		$f = 0.92 \frac{a^4 b^2}{(a^2+b^2)^2} \cdot \frac{p}{t^2}$ (48) $t = 0.959 \frac{a^2 b}{a^2+b^2} \sqrt{\frac{p}{f}}$ (49) $p = 1.087\, ft^2 \left(\frac{a^2+b^2}{a^2 b}\right)^2$ (50) $\Delta = 0.19 \frac{a^4 b^4}{(a^2+b^2)^2} \cdot \frac{p}{Et^3}$ (51)	Rectangular plate of sides=a and b, supported at the edges and uniformly loaded. Formulæ due to Navier.
15		$f = \frac{1}{2} \left(\frac{a^4}{a^4+b^4}\right) \frac{b^2}{t^2} p$ (52) $t = 0.707\, a^2 b \sqrt{\frac{p}{(a^4+b^4) f}}$ (53) $p = 2 ft^2 \left(\frac{a^4+b^4}{a^4 b^2}\right)$ (54) $\Delta = \frac{1}{32} \cdot \frac{p}{Et^3} \left(\frac{a^4 b^4}{a^4+b^4}\right)$ (55)	Rectangular plate of sides=a and b, fixed at the edges and uniformly loaded. These formulæ are due to Grashof, same remark as for No. 11 applies here
16		$f = 2.28 \frac{a^2 b}{(a^2+b^2)^2} \cdot \frac{P}{t^2}$ (56) $t = \frac{1.51}{a^2+b^2} \sqrt{\frac{a^3 b P}{f}}$ (57) $P = 0.438\, ft^2 \left(\frac{a^2+b^2}{a^3 b}\right)^2$ (58) $\Delta = 0.46 \frac{a^4 b^4}{(a^2+b^2)^2} \cdot \frac{P}{Et^3}$ (59)	Rectangular plate of sides=a and b, supported at the edges and loaded at centre Formulæ due to Navier To facilitate the problem the load is supposed to apply at one point, in reality it is applied upon a small surface
17		$f = \left(\frac{2a-b}{4a}\right) \frac{b^2}{t^2} p$ (60) $t = \frac{b}{2} \sqrt{\left(\frac{2a-b}{a}\right) \frac{p}{f}}$ (61) $p = 4ft^2 \frac{a}{b^2(2a-b)}$ (62)	Elliptic plate, major axis=a, minor axis=b, supported along the edge and uniformly loaded.
18	 Cylindrical shell Spherical shell	Cylinder $f = \frac{pd}{2t}$ (63) $t = \frac{pd}{2f}$ (64) $p = \frac{2ft}{d}$ (65) Sphere $f = \frac{pd}{4t}$ (66) $t = \frac{pd}{4f}$ (67) $p = \frac{4ft}{d}$ (68)	Cylindrical shell of diameter=d, subjected to an internal uniform pressure. Spherical shell of diameter=d, subjected to an internal uniform pressure.

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FIG. 2. THE STRENGTH OF SQUARE, RECTANGULAR AND ELLIPTICAL PLATES.

made on flat plates, described in Mr. W. Kent's hand book, and about which a Mr. Wilson has drawn some very curious conclusions, condemning all the "authorities" in a bunch, just because he applied Grashof's formula, modified by Rankine, to the wrong case, mistaking a flexible wrought-iron plate for a rigid one, such as might be one of cast iron.

The following table gives the notation used in the formulas:

a = side of square, in inches.
a = longest side of rectangle, in inches.
a = major axis of ellipse, in inches.
b = minor axis of ellipse, in inches.
b = smaller side of rectangle, in inches.
d = diameter of plate, in inches.
d_1 = inner diameter of plate, in inches.
Δ = deflection of plate, in inches.
E = modulus of elasticity.
f = allowable stress, in pounds per square inch.
K, K_1, K_2 = coefficients.
p = uniform pressure, pounds per square inch.
P = concentrated load, in pounds.
t = thickness of plate, in inches.

Tools For Automobile Tire Valves.

BY JOSEPH V. WOODWORTH.

The making of the valve for pneumatic tires for automobiles, shown in Fig. 1, involved both press and screw machine work; a description of the punches, dies and tools used may be useful and suggestive for other work. At first the shells were made entirely in the screw machine from round bar brass, but the waste was considerable, so the method here shown was adopted—that is, drawing them from sheet brass blanks. These blanks, of ⅛-inch sheet brass, were supplied in lots of 100,000 at a price below what it would have cost us to produce them. The press operation comprised drawing the flat blank to the shape shown at *A*, Fig. 1, and then blanking the hole in the bottom, as at *B*. As the blank was of comparatively heavy stock, a simple and inexpensive die could be used.

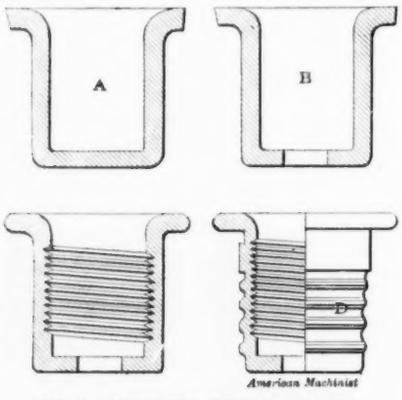


FIG. 1. VALVE FOR PNEUMATIC TIRE.

This die, Fig. 2, is a simple drawing die. *C* is the bolster, of cast iron, bored and finished to admit the drawing die *A*, and the knockout pad *D* and die *A* resting squarely within the bolster at *B* and the knockout pad at *E*. A clearance hole runs down through the bolster for the shank of the knockout. Two set-screws *F F* were let into the side of the bolster, at an angle as shown, to keep the die *A* securely in position. The die is finished to the exact size and at the top to the shape of the outside of the shell *A*, with a depression let into the face for the flat blank *G*, this serving as the gage. This die is well polished, and tapered inwardly toward the bottom nearly 1 degree, and is left very hard. In the punch, *I* is the holder and *H* the punch, the latter in diameter two thicknesses of metal less than the diameter of the die. The set-screw J holds it. In operating, the blanks are first coated with heavy hot grease, poured over them. One is placed in the recess on the die, and as the punch descends it is drawn and formed to the shape A. As the punch ascends a knock-out strikes the knockout pad *D* and raises it sufficiently to strip the shell from the die. When metal as thick as here shown is to be drawn, neither blank-holder, pad nor rubber spring barrel is required, as the thickness of the blank, in proportion to the small diameter to which it is drawn, prevents crimping or wrinkling.

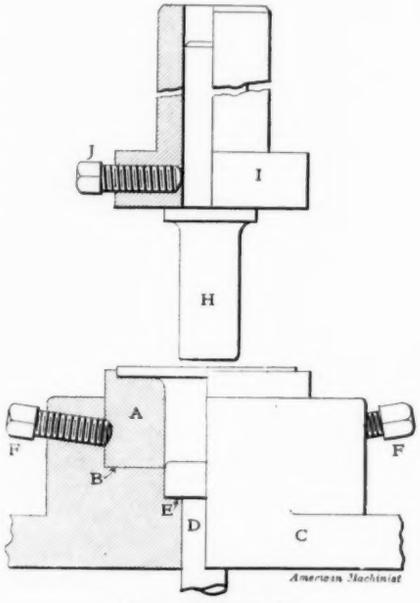


FIG. 2. DRAWING DIE.

For the hole in the bottom of the shell the punch and die, Fig. 3, were used. *K* is the bolster, of cast iron; *M* the die, and *N* the gage plate, of tool steel. *P* is the stripper, bent to the shape shown and fastened to the back of the bolster. *R* is the punch and *H* the holder. The shell A is placed in the gage plate *N*, and the punch descending blanks the hole; the shell is stripped from the punch by the stripper *P*. In drawing the shell and blanking the hole stock is left for finishing in the screw machine—that is, to finish the top, the inside and the hole and to finish the outside, as shown at *D*, Fig. 1.

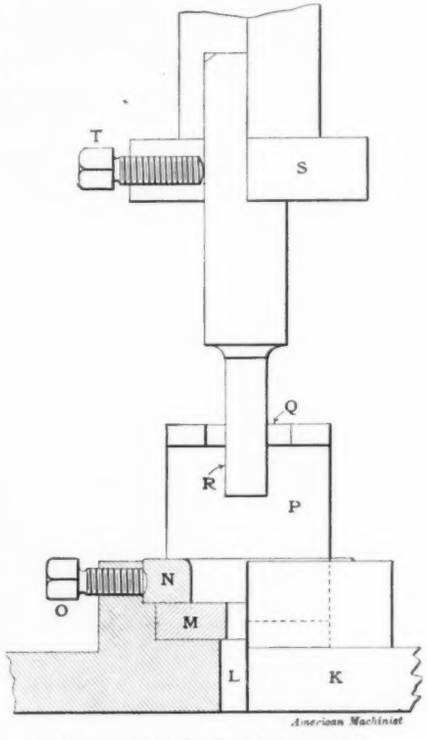


FIG. 3. PUNCH FOR BOTTOM HOLE.

For finishing three tools were required: the tap, the internal forming and the finishing tool. There were three sizes of shells made, all of the same thickness and hight, but of different diameters. As it was necessary to finish and size the inside of this shell before tapping, the adjustable internal forming tool, Fig. 4, was made. This tool would expand or contract the cutter to produce either of the three sizes required. The body was first turned, the shank *U* to fit the turret head, the body to 1 11-16 and the front *W* to ⅝ inch diameter. A thread of 12 pitch was cut around the body. The two slots *X X* were milled in, running off at an angle of 5 degrees on each side. A small end mill was then used to mill the T-head in the bottom of each slot. The side of the slot against which the cutting face of the cutter was to rest was radial. Two round machine-steel nuts *Y Y* were made to fit the body, heavily knurled and faced true, with three holes for a spanner.

The making of the cutter was a more difficult job. Two pieces of flat tool steel were upset on the back to form the tongues *A* and *B* on each side, and these pieces were then milled to fit the T-slots *X X* snugly and smoothly all over. They were then finished, as shown, with the projection at *C*, entered into their respective positions in the holder, and the adjusting rings brought up, tightly holding them in position. The holder was then run in the lathe and the cutters were turned on the cutting edge to a templet. They were then removed, clearance was filed on the

cutting edges, they were carefully hardened and drawn to a light straw color. When replaced in the holder they were adjusted by the ring nuts to the diameter required. The tool was then set in the screw machine, the shell was held in the spring chuck, the tool was run up and the cutters finished the inside, faced the front and finished the hole. When finishing the cutters the same angle of clearance was given at all cutting points, so as to facilitate grinding without changing the shape, always grinding the tool from the face backward and all cutting edges the same amount, which was done to gage.

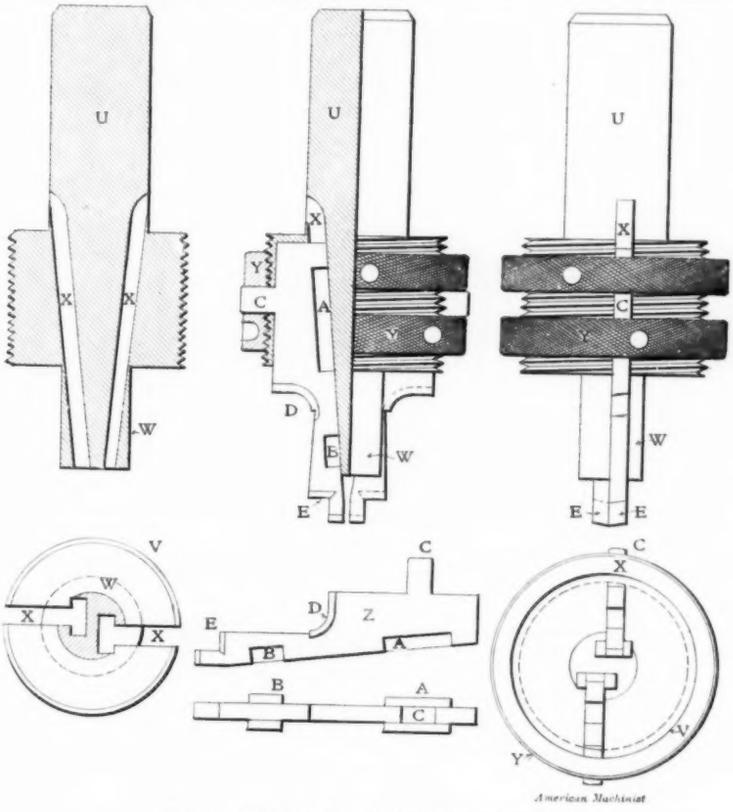


FIG. 4. TOOL FOR FINISHING THE INSIDES.

For finishing the outside of the shells, they were screwed on to a threaded plug held in the spring chuck and a circular forming tool was used. The tool Fig. 4 can be used to advantage for external as well as for internal work.

Peculiarities of German Patent Office Practice.

United States Consul Frank H. Mason sends us from Berlin the following interesting account of the particulars in which the practice of the German Patent Office differs from that of the United States, with valuable suggestions as to how many troubles may be avoided:

It is a matter of common knowledge among inventors and others who are interested in patent-law practice that, while the United States and Germany are by common consent the two countries in which inventions are most intelligently and thoroughly examined, and in which, therefore, a patent once obtained is most valuable, there are certain radical differences in the methods of the Patent Offices at Washington and Berlin which, being often misunderstood, lead to disappointments, recriminations and litigation which more exact knowledge might have averted.

It is not uncommon to hear American and other foreign inventors complain of a hostile and forbidding attitude on the part of the examiners at the German Patent Office, as though the duty of the latter were to assume that every invention presented for a patent is defective or plagiarized until the contrary is proven—in other words, to discourage rather than encourage the protection of meritorious inventions by patent. It requires but slight experience in such matters to show that in many, if not a majority, of the cases the troubles of American inventors at the German Patent Office are due to their failure to realize the difference in the two systems of application, by reason of which an application which would be correct at Washington would inevitably fail at Berlin for informalities which any clerk in a patent lawyer's office should recognize and be able to correct.

In the first place, a foreign inventor may not deal directly with the imperial German Patent Office. He must be represented here by a patent attorney of recognized standing, by whom the application and specifications are presented, and through whom additional details or explanations may be asked for by the examiners. This does not mean, however, that the foreign inventor need necessarily send his application through a long international chain of offices, which may not infrequently involve needless delay and expenses. There is kept at the German Patent Office a list of recognized patent attorneys who are located in Berlin and throughout the Empire.

Secondly, specifications and claims for patents on American inventions are frequently presented in the form of translations made by persons who have only an acquired and superficial knowledge of German. Such translations, made with the aid of a dictionary, mechanically translate the words, and not the meaning, of important phrases, so that the specifications and clauses as filed are often incomprehensible. This entails additional correspondence, corrections and frequently long delays which might have been avoided. Few persons, comparatively, are capable of translating a technical description so that it shall mean exactly the same in a foreign language as in the original, and it is this want of exact completeness that often loses a foreign patent or renders it, if gained, loose in its provisions and impaired in value.

Many inventors and even some attorneys in the United States seem not to understand that Section 2 of the German patent law prescribes that an application for a patent in this country must be filed (1) before the invention has been disclosed in any generally accessible publication during the past hundred years and (2) before it has been so publicly used or exhibited in Germany that anybody skilled in the art to which it relates could carry out and utilize the invention.

This differs radically from the United States statute, which allows the first inventor to obtain a patent on his invention even after it has been made known (except by previous patent, in which case the application must be filed within seven months after the date of the application for said previous patent), provided he files his application within two years from the time when the invention was first publicly disclosed. A want of exact knowledge concerning this variation between the practice of the two countries leads to the presentation of American claims in Germany which cannot be granted, because the antecedent record of the invention in respect to publicity is in violation of the German law.

But the chief difficulty, upon which more hopes are wrecked than any other, is the radically different view taken by the American and German authorities as to what constitutes a single patentable invention. This difficulty is more especially obvious and serious in the case of a machine composed of a number of parts, on each of which priority of invention is claimed. Patents are granted in the United States for new constructions and combinations which in Germany would be required to be divided and covered by sev-

eral different patents. Consequently, applications are often received here which, being substantially translations of specifications prepared for use at Washington, have to be rewritten and divided into two or more individual devices before any examination can take place. This, of course, entails delay, expense, and introduces a new element of uncertainty into the case, since one or more of such separate claims, which are all covered by one American patent may be rejected by the German examiners.

As an example of this fundamental variation in practice may be cited the sample specification and claims on improvements in a meat-chopping machine which is given in the Rules of Practice published by the United States Patent Office. The preamble states as follows the three objects to be obtained by the invention, viz.:

(1) To provide a continuously lubricated bearing for the chopping block;

(2) To afford facilities for the proper adjustment of the knives independently of each other in respect to the face of the block; and

(3) To reduce the friction of the reciprocating rod, which carries the knives.

Then follow the four claims setting forth the separate elements of the machine by which these three problems are solved, and protection is afforded for the elements in the combinations by which the desired results are reached. To facilitate the reference, the exact wording of the clause is herewith given:

"(1) The combination, in a meat-chopping machine, of a rotary chopping block having an annular rib, with a table having an annular recess and a pocket communicating with the said recess, all substantially as set forth.

"(2) In a meat-chopping machine, the combination of a rotary chopping block with a reciprocating crosshead carrying knives, each of which is vertically adjustable on the said crosshead independently of the other, substantially as described.

"(3) The knife *d*, having two screw rods *m m* attached to its back, substantially as shown, for the purpose specified.

"(4) The combination, in a meat-chopping machine, of the reciprocating rod, carrying the knives, the crosshead secured to the said rod, and having antifriction rollers, with guides, adapted to the said rollers, all substantially as set forth."

Now, a German patent claim is what is known in American practice as "functional." It provides protection for the means employed in the solution of a problem, and characterizes the different elements by which the solution is obtained by their functions, instead of by their arrangement and combination. For instance, claim 1 of the foregoing series would need to be rewritten for the German examiners into a form substantially as follows, which would of course be expressed in clear, idiomatic German:

"A meat-chopping machine, in which vertically reciprocating knives operate in conjunction with a rotating chopping block, characterized by the fact that a rib provided on the under side of the rotating chopping block moves in an annular groove provided in a table and connected with a depression or recess filled with oil, for the purpose of sufficiently lubricating the block."

If such a claim were accepted in Germany as the first or principal claim, all the other claims in the same application would have to fall within its scope—that is, assist in obtaining the same end as is obtained by the first claim. But it is inadmissible in Germany to introduce the solution of a new problem in the second or following claims, so that in the instance above recited from the "Rules of Practice," the second claim, which covers the combination of elements for obtaining the second object stated in the preamble, could not be included in the same German application as the claim 1, above quoted, because it relates to a different problem, or, in other words, is based on another and independent inventive idea.

It is impracticable within present limits to follow the comparison through in all its details, but it will be sufficient to say that these claims and specifications, covering three independent improvements on a known machine, and which can legally be covered by a single patent in the United States, would require three separate patents in Germany.

Each claim in the United States must be complete in itself, which not only means that no reference may be made from one claim to another, but also that each claim must cover a combination quite separate from and independent of the other claims. Quite the opposite is the case in Germany. Here, the first claim is a statement of the invention, and all other claims must fall within the same scope. In this country, any number of "modifications" may be introduced in the subsidiary claims, while in the United States "alternative constructions" are inadmissible, and subject-matters introduced as "modifications" in subsidiary claims in Germany can only be properly claimed in the United States as new combinations, quite separate from and independent of the other claims.

Still another source of error is the lettering of drawings which accompany applications for German patents on inventions which have already been patented in the United States. In most cases the preamble, specifications and claims are translations of the English text, in which a lever, for instance, is designated by *L*, a crank by *C*, a pinion by *P*, and so on. As the German rule requires that the first reference letter alluded to in the text must be *A*, the second *B*, and so on throughout, it is plain that the English initial letters, when fitted into a German translation in which lever is rendered by "Hebel," a crank by "Kurbel," etc., would not only be misleading, but meaningless.

An American inventor, who has had long experience in securing foreign patents for his inventions, gives it as his opinion that "two-thirds of the first rejections of American applications for German patents and the failures of American inventors to secure prompt attention and early issue are justified by the loose, informal manner in which they are presented, and this often by international patent attorneys of large experience and high ability, but who are prevented by the great volume of their business from giving personal and expert attention to details which they know, or ought to know, to be prescribed by law and therefore of the first importance."

The subject is one of immediate and steadily growing interest. No foreign people apply for and obtain so many patents in the United States as Germans, and in no country is it more necessary and to the advantage of American inventors to protect their inventions by patents than in Germany. A clearer and more exact understanding of the many differences in practice and theory between the two countries, of which the foregoing are typical examples, would save not only time and money, but avert friction and litigation which might well be avoided.

Some Reasons for Increasing the Obliquity of Involute Teeth.

BY ROBERT A. BRUCE.

The most obvious advantage to be gained by increasing the commonly accepted angle of obliquity for involute gearing lies in the fact that as the obliquity increases the limiting number of teeth in the smallest pinion of a set where interference is avoided, rapidly diminishes. Thus with an obliquity of 22½ degrees a pinion of 14 teeth needs no correction for interference, while the correction to be applied to a pinion of 12 teeth working with a rack is so slight as to be hardly noticeable. This point is well known and has been fully discussed.

The next advantage in order of importance is the increased strength of teeth as the obliquity is augmented, and the object of the present article is to discuss this aspect of the question and to show that incidentally both the efficiency and wearing qualities of the teeth are appreciably improved.

At the outset it is necessary to establish a sound method of comparing wheels whose teeth have differing involute profiles. For this purpose it is not merely sufficient to select wheels of the same diameter and width and with the same number of teeth, since when running at the same speed greater loads can be carried as the obliquity is increased. Thus a mere glance at Fig. 1 will make it evident that the pinion *A* containing 16 teeth (obliquity 22½ degrees) will transmit a greater load than *B* with same number of teeth (obliquity 15 degrees).

The following, which seems to be a more natural course, is the method of comparison which has been adopted in this investigation: Wheels of the same diameter and width running at the same pitch line speed and transmitting the same maximum load at the pitch line may be termed "equivalent wheels," their ideal pitch surfaces being identical, and their transmission properties the same.

In any discussion of the relative merits of differing profile systems it is sufficient to compare "equivalent wheels," selecting the profile which promises the best efficiency and wearing qualities, providing that there are no counterbalancing disadvantages.

At the outset it becomes necessary to establish the relationship between load and pitch. This has already been done in a manner leaving little to be desired, by Lewis, for teeth of 15 and 20 degrees obliquity, and the values of y or the "strength factors" for these angles have been plotted in Fig. 2 (curves B and D), the remaining curves (A and C) giving with close accuracy the values of y for 17½ and 22½ degrees obliquity. These latter results have been obtained by graphical methods in a few selected cases, and the curves themselves have been interpolated. The circles and crosses represent the values as found by graphical methods. The assumptions made agree with those made by Lewis in his original investigation. It is supposed that the whole load may be concentrated at the point of one tooth acting in the direction of the arrow in Fig. 1, the intersection of this line and the center line of the tooth being at A. The strength of the tooth may now be determined by drawing through A a parabola inscribed within the profile and touching it at one point B, which in consequence marks the weakest section of the tooth. Joining A and B

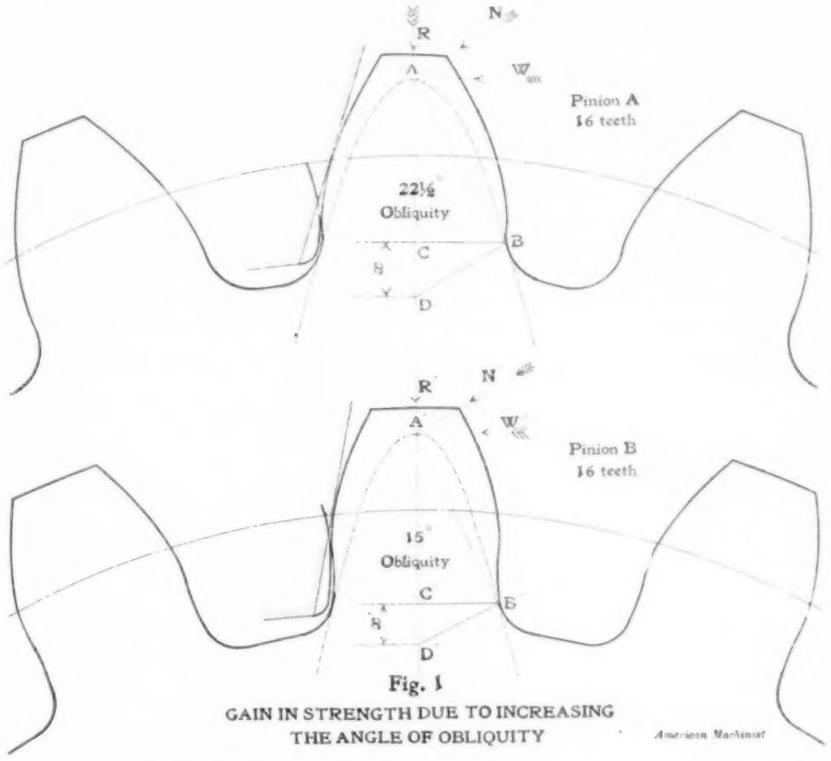
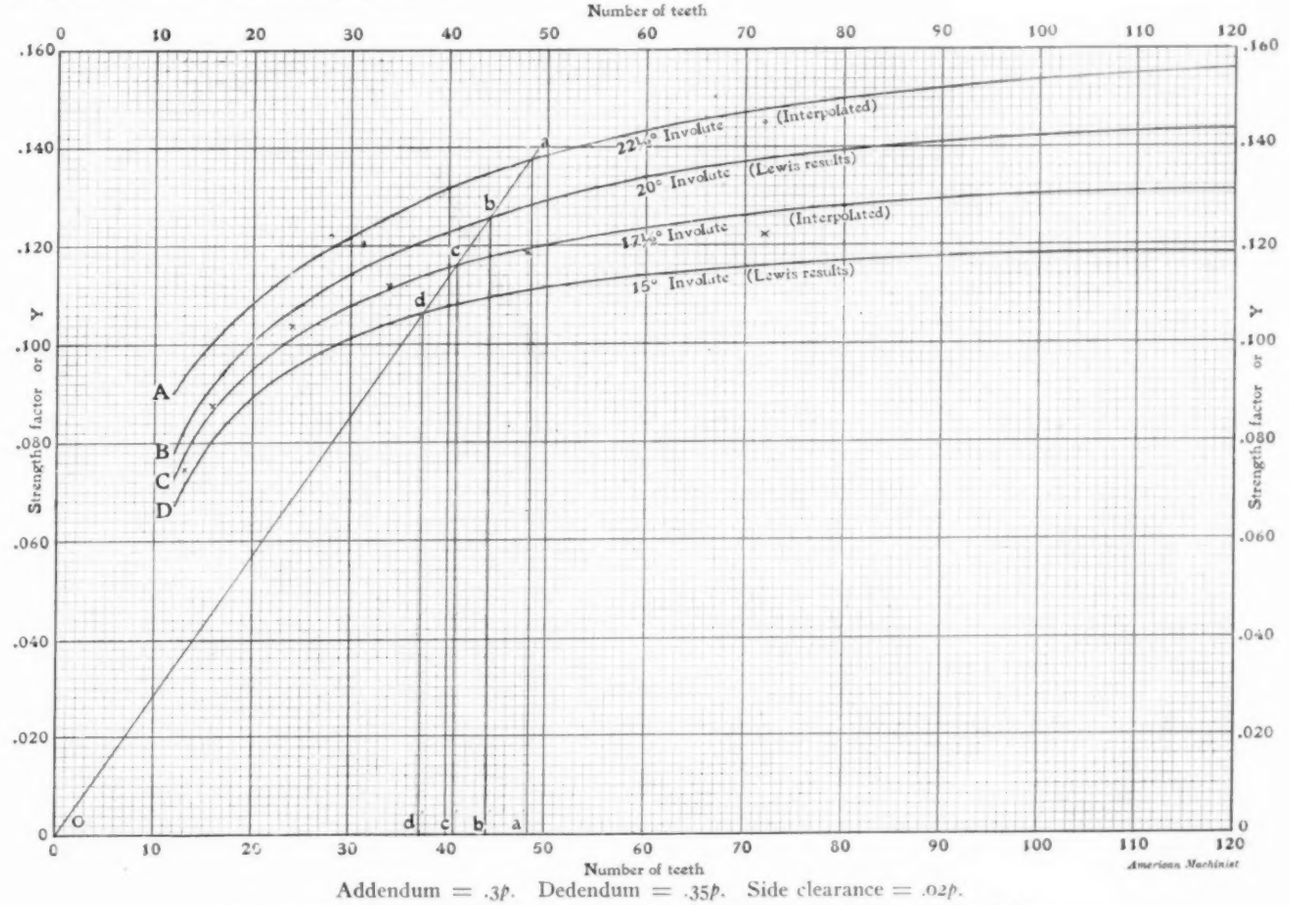


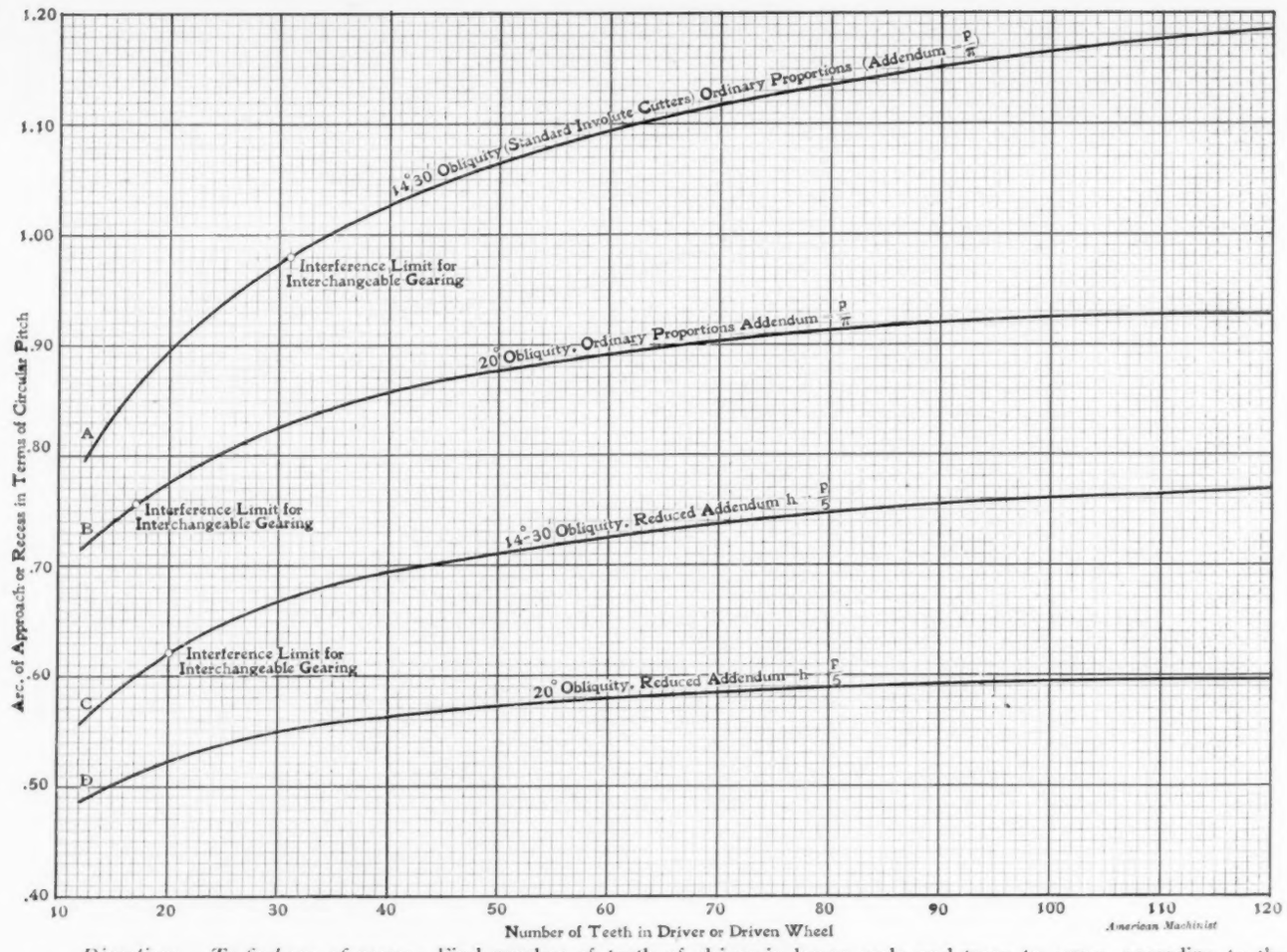
Fig. 1

GAIN IN STRENGTH DUE TO INCREASING THE ANGLE OF OBLIQUITY



Addendum = $.3p$. Dedendum = $.35p$. Side clearance = $.02p$.

FIG. 2. VALUES OF y IN FORMULA FOR WORKING STRENGTH OF GEAR TEETH—$W = p\,f\,s\,y$.



Directions.—To find arc of recess: Find number of teeth of driver in lower scale and trace to curve according to the obliquity; thence find arc of recess in terms of circular pitch by tracing horizontally from curve to left hand scale.

To find arc of approach: Follow the same process, but use the number of teeth in the driven wheel.

Arc of contact = arc of approach + arc of recess.

FIG. 3. ARC OF CONTACT OF INVOLUTE TEETH.

and drawing $B\,D$ at right angles to $A\,B$ and $B\,C$ at right angles to the center line of the tooth, the length $C\,D$ (marked x in the diagram) is a measure of the load that can be borne by the tooth. The strength factor y is in fact related to x by the equation:

$$\frac{2\,x}{3\,p} = y. \qquad (1)$$

while the relation between the safe load and the dimensions of the teeth is:

$$W = s\,p\,f\,y \qquad (2)$$

where

f = breadth of face of the teeth in inches,

W = safe load in pounds,

p = circular pitch in inches,

s = safe stress on the teeth,

$$= 8000\left(\frac{600}{v+600}\right) \text{ for cast iron}$$

$$\text{and } 20000\left(\frac{600}{v+600}\right) \text{ for steel,}$$

v being the pitch line speed in feet per minute.

By the aid of Fig. 2 it is extremely easy to find "equivalent wheels." Suppose, for instance, that it is found necessary to use, for a certain transmission, a wheel of 41 teeth, 1-inch pitch, when the profiles are involute curves of 17½ degrees obliquity, the proper pitch and number of teeth for any other obliquity would be found as follows: On curve C locate the point c giving the strength factor for 41 teeth, and join this point to the origin O by a line extended to cut the other curves at a, b and d, then these points give the number of teeth of "equivalent wheels" for the obliquities named on the curves.*

*The truth of this statement can easily be demonstrated, as follows: The strength of a tooth of a wheel which locates the point c (i. e., the wheel has 41 teeth and the angle of obliquity is 17½°) is proportional to the line $c\,c'$. If, therefore, we consider the case of a second wheel of the same pitch diameter and pitch line speed, located, we will suppose, by the point a on the line $o\,c\,a$ (i. e., the second wheel will therefore have 48 teeth of 22½° obliquity), the strength will be reduced in virtue of the reduced pitch in the ratio $\frac{c'o}{a'o}$ but in respect of its stronger form it will be increased in the ratio $\frac{a'a}{c'c}$. When these causes are simultaneously operative, since $\frac{a'a}{c'c} = \frac{a'o}{c'o}$ therefore $\frac{a'a}{c'c} \cdot \frac{c'o}{a'o} = 1$, showing that the strength is maintained, since the strength of the second wheel is proportional to $c'c \times \frac{a'a}{c'c} \times \frac{c'o}{a'o}$ or to $c'c$, as before.

Thus the point a indicates that if an obliquity of 22½ degrees is to be used the pitch may be diminished till the number of teeth in the wheel is 48, while with an obliquity of 15 degrees it would be necessary to increase the pitch till the number of teeth was reduced to 37. It is hardly necessary to say that it would not always be possible to carry out the alteration precisely as described on account of its leading to irregular pitches. Nevertheless, a very substantial reduction of pitch is usually attainable on increasing the obliquity.

The advantage of latitude in this direction will be recognized when it is stated that if compelled to use a pinion of 12 teeth with the ordinary obliquity, on increasing the obliquity to 22½ degrees it would be possible while retaining the same size wheel as regards diameter and width of face to diminish the pitch sufficiently to enable a pinion of 18 teeth being used to transmit the same load.

It has been stated that the obliquity of action in involute gearing has no effect whatever upon the friction loss in the teeth themselves. This statement, though true, is misleading. With wheels of a given size and with a given arc of approach

and recess the friction is independent of the obliquity, but when it is remembered that the increase of the obliquity reduces the arcs of approach and recess for wheels of a given size, it will be found that even for wheels of the same size and pitch the efficiency increases with the angle of obliquity of the teeth. When, moreover, in addition to increase of obliquity there is diminution of pitch, the increase of efficiency becomes more marked.

If a = the length of the arc of approach in terms of the circular pitch,
b = the arc of recess measured in the same terms,
R = the pitch radius of the wheel,
r = the pitch radius of the pinion, and
μ = the co-efficient of friction between the teeth.

The ratio $\dfrac{\text{Work wasted in friction}}{\text{Work transmitted by wheels}} = \dfrac{\mu\,(a^2 + b^2)\,(R + r)}{2\,R\,r\,(a + b)}$

In order to compare the losses in wheels with teeth of different obliquities it is necessary to know the values of a and b. Fig. 3 has been constructed for this purpose, giving the values of a and b for certain angles of obliquity.*

In order to demonstrate the gain in efficiency as the obliquity is increased, it will be sufficient to take an actual example and calculate the ratio of work wasted to that usefully performed. For this purpose consider the case of a pair of wheels with 20 and 80 teeth of 2 inches pitch.

Then $R = 25.48$, $r = 6.36$

and hence $\dfrac{R + r}{R\,r} = .197.$

If the obliquity of the teeth is 15 degrees and the pinion drives, a = arc of approach = 2.22 inches and b = arc of recess = 1.76 inches. Hence

$$\frac{\text{Work wasted}}{\text{Useful work}} = .20\,\mu.$$

If the number of teeth is retained and the sole change is an increase in the angle of obliquity to 22½ degrees, a = 1.47 inches and b = 1.68 inches, giving

$$\frac{\text{Work wasted}}{\text{Useful work}} = .157\,\mu,$$

or the lost work is reduced by 22 per cent.

Taking full advantage of the superior strength of the teeth with the greater obliquity of action, so as to obtain "equivalent wheels," the sizes and ratio will be little altered if we employ wheels of 26 and 102 teeth and $1\frac{0}{18}$ pitch, and we obtain the ratio $\dfrac{\text{Work wasted}}{\text{Useful work}} = 123\,\mu,$ showing a still more marked gain.

It will probably be readily admitted that the gain in efficiency is more than enough to counterbalance any slight loss due to friction at the bearings, which will naturally be greater (though very little greater) with the higher obliquity.

The above reasoning may fail to convince some readers, but it is easy to show that a diminution of the arc of contact leads to an increase in efficiency.

Referring to Fig. 4, two involute teeth are represented in contact at p', the contact path being $A\,B$, terminating on the addendum circles and passing through the pitch point p. At the instart considered the rate at which sliding takes place between the profiles may be looked upon as due to the rotation of one pitch surface about the other (p being therefore the center of rotation for the instant considered) with an angular motion equal to the sum of the motions of the wheels about their axes. At the point illustrated, the velocity of rubbing will be proportional to $p\,p'$, while at the commencement and end of contact the velocities of sliding would be respectively proportional to $p\,A$ and $p\,B$. The work wasted during the time that the contact path $A\,p$ is traversed may be represented graphically by the area of a triangle $p\,a\,A$, while if the contact path be reduced to $p\,A'$, by reducing the pitch, the work expended in friction will be proportional to $p\,a'\,A'$, provided that the normal pressure between the teeth remains the same. At the same time also the useful work will be proportional to $A\,p$ in the one case and $A'\,p$ in the other. Now, since the areas of similar figures are proportional to the squares of their like sides, it follows that while the wasted work is reduced in the ratio $A\,p^2$ to $A'\,p^2$ the useful work is reduced only in the simple ratio $A\,p$ to $A'\,p$. Finally, extending the reasoning to the contact path $p\,B$, while the useful work during the whole contact path is reduced from $A\,B$ to $A'\,B'$ the wasted work is reduced from the (sum of areas $A\,p\,a$ and $B\,p\,b$) to (sum of areas $A'\,p\,a'$ and $B'\,p\,b'$), or from $A\,p^2 + B\,p^2$ to $A'p^2 + B'\,p^2$. Again, a similar process of reasoning can be applied to a case when reduction of the contact path takes place simultaneously with a change in the angle of obliquity. From a purely practical point of view, reduction of wear is almost more important than diminution of the loss due to friction.

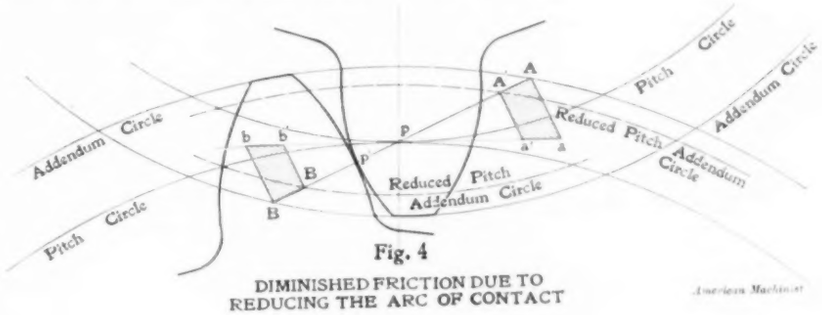


Fig. 4

DIMINISHED FRICTION DUE TO REDUCING THE ARC OF CONTACT

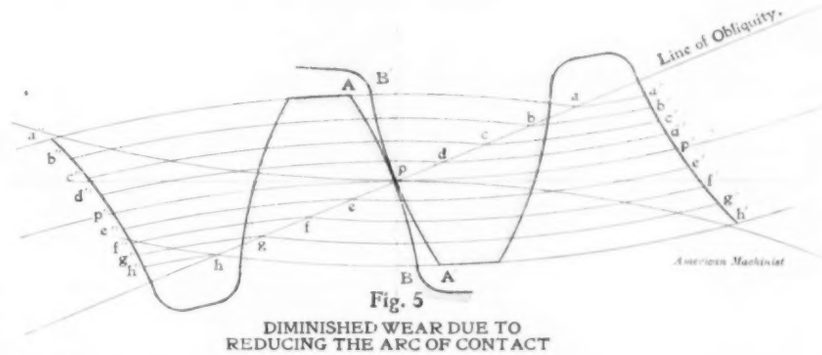


Fig. 5

DIMINISHED WEAR DUE TO REDUCING THE ARC OF CONTACT

In the case of involute teeth the path of contact being a straight line, the normal pressure between the teeth varies only in respect to the number of teeth simultaneously engaged. Thus with the standard angle of 15 degrees, if the wheels are equal and the number of teeth in each exceeds 42, the load is shared between at least two pairs of teeth. As the obliquity increases, however, the load is increasingly borne by a single pair of teeth. This fact, however, does not necessarily lead to increased wear. In order that this point may be clearly realized, it is necessary to explain the fundamental principles upon which wear depends. In Fig. 5 a pair of teeth are shown in contact at p, the pitch point, and the path of contact is $h\,a$, which has been divided into eight equal parts, as shown, by the points b, c, d, p, e, f and g. Circles concentric with

*The addendum has been supposed to be $.318\,p$ in the calculations from which the curves in Fig. 3 have been derived. The formula used is

$$a = \frac{n\,p}{2\,\pi\cos.\,\theta} \times \left[\left\{\left(1 + \frac{2}{n}\right)^2 - \cos.^2\theta\right\}^{\frac{1}{2}} - \sin.\,\theta\right]$$

where θ is the angle of obliquity. It should be noticed that no error is introduced due to the fact that the addendum in Fig. 2 has been taken as $.3\,p$, since the comparative strengths of the teeth will remain sensibly the same, and it is comparative, and not actual, strengths with which we are now concerned.

the pitch lines have been drawn through each of these points so as to mark off points a', b', etc., and a'', b'', etc., on the faces of the two profiles. It is evident that while the point of contact traverses the portion $h\,g$ of the contact path, contact which at the commencement took place between a' and a'' is transferred to the points b' and b''. As the teeth during this time have been continuously in contact, an amount of sliding equal to $a''\ b'' - a'\ b'$ has taken place, and this sliding will have a more serious effect in wearing the roots of the teeth than the points, since in the former case it is distributed over a smaller length of profile. Applying the same reasoning to the portion of the path $b\,c$, the amount of sliding is $b''\ c'' - b'\ c'$, which is distributed over the lengths $b''\ c''$ and $b'\ c'$ respectively. Again the wear is more serious for the flanks than the points, but not so much as at the commencement of contact. The wear in fact is very much increased as the point of contact recedes from the pitch point both for the face and the flank, being, however, in the latter case vastly more serious. The effect of increasing the obliquity is to very materially decrease the distance of the extremities of the path of contact from the pitch point, while very slightly increasing the normal pressure between the teeth. The net effect is therefore to very materially reduce wear at the very point where wear is most deleterious.

New Brompton, England.

Letters from Practical Men

Effect of Altering the Addendum on the Limiting Number of Gear Teeth.

Editor American Machinist:

Referring to Mr. Bruce's paper in your issue No. 35, it may be worth while pointing out that the minimum number of teeth in a pinion of any given addendum may be found by multiplying together this preferred addendum, the diametral pitch and the number of teeth—as given in the vertical column on the left in the diagram accompanying the paper mentioned in the outset—corresponding to the original addendum $\frac{1}{D}$.

That what precedes is correct may be seen from the following consideration:

Let the addendum be assumed as $\frac{x}{D}$ instead of the usual amount $\frac{1}{D}$; then equation (1) of Mr. Bruce's paper becomes:

$$A\,M = \frac{1}{2\,D}(r\,n_a + 2\,x) \qquad (1)$$

and equation (4) becomes:

$$(r\,n_a + 2\,x)^2 = (n_a \cos.\, i)^2 + n_a^2\,(r+1)^2 - 2\,n_a^2\,(r+1)\cos.^2 i \qquad (2)$$

Solving for n_a we have:

$$n_a = \frac{2\,x}{\sqrt{(2\,r+1)\sin.^2 i + r^2 - r}} = n\,x \qquad (3)$$

From this we see that the only effect of altering the addendum is to change n in exactly the same ratio.

But by hypothesis $\frac{x}{D} = A =$ preferred addendum. Therefore $n_a = n\,D\,A$ where n_a is the number of teeth corresponding to the addendum, A.

I have thought that the foregoing suggestion might be pertinent in view of the fact that reputable engineers everywhere are urging the adoption of shorter teeth.

After some consideration of the matter it seems clear to me that where smoothness of action, enhanced strength and higher efficiency are the desiderata, then short teeth are preferable. It needs no argument to show that, other things unchanged, shorter teeth are stronger. That the efficiency will be higher with short teeth than with long ones is due in part to each of two things: First, with shorter teeth, for a given number of horse-power transmitted, the pitch may be less, and thus the number of teeth greater and the friction less, since the greater the number of teeth the less the friction. It would be better perhaps to say, instead of friction, the work due to friction. Second, with shorter teeth the angle of action may be less without increasing the minimum number of teeth to avoid interference, and hence the pressure on journals will be lessened, with a consequent diminution of loss work due thereto. That the action will be smoother follows, of course, from the fact that the friction is less.

W. H. Rasche.

Varnishing Patterns.

Editor American Machinist:

The articles which have recently appeared in your columns touching on various phases of pattern-making, written, as they were, by practical men, were certainly very helpful and suggestive. To those engaged in the trade, a careful perusal of them could not fail to impart a fund of information at once practical and profitable. Personally, I can bear testimony to their real merit in the valuable suggestions which I have received touching several important points. I have felt well repaid for the close and careful reading of these articles.

Another matter relating to this same general subject which deserves attention, but which, I think, has not been touched upon by any previous writer, is the varnishing of patterns. This is the last and finishing touch before their leaving the pattern shop for the foundry; but though the last, it is by no means to be regarded as an unimportant one. To varnish patterns right is an art little understood by many members of the craft. The varnishing has much more to do with the appearance and utility of a piece of work than many are inclined to think. Many a good pattern has been marred in looks and impaired in durability by lack of attention to this one thing.

Three reasons may be assigned for varnishing wooden patterns: First, to give a neat and finished appearance; second, to secure a smooth surface that will insure easy draft from the sand; third, to impart a hardened surface to the wood which will increase its durability. To secure these three ends is well worthy the ambition of every good, conscientious mechanic, and will well repay him for his trouble. In fact, if he has any regard for his reputation for good workmanship he cannot afford to be careless regarding this last detail.

A few hints touching this point may not be amiss. The varnish used ought always to be quite thin, so as to insure its easy and rapid spread. The reason for this is clear. Shellac, or yellow varnish, as every patternmaker knows, dries so quickly that to have it thick at the start, adds greatly to the difficulty of spreading it evenly. As a result of using the varnish too thick the pattern presents a streaked, if not a bedaubed, appearance. More than one splendid piece of work I have have seen marred because of failure to give proper attention to this one little detail. Of course some will object to this suggestion on the ground that in their belief the thicker the varnish is the better. A thicker and harder coating will be imparted to the wood than when the varnish is thin. Well, it may appear so at first sight, but a moment's thought will suffice to show that a thin varnish, being more penetrating, will help to fill up the pores in the wood to better advantage and at the same time secure just as smooth and hard a surface. In the end, it affords a far better protection to the pattern and by its smooth, even appearance adds greatly to the attractiveness of the workmanship.

Another matter worthy of more than passing consideration is the kind of brush to be used. Many prefer a round, stocky brush for the spreading, but such is better suited for paint than for varnish. Long and varied experience has taught me that the best kind of brush to use for this purpose is a light, flat one, such as is ordinarily used by painters for that special work. By the use of such a brush the spreading can be done far more evenly and rapidly, which latter is a consideration never to be ignored. Such a brush can always be obtained at a nominal price—perhaps ten or fifteen cents.

Just a word about the use of black varnish. Usually this is employed for prints and core-boxes, and these are blackened in order to guide the molder in placing his cores. But there are times when black varnish is used to cover the whole pattern. Many, indeed, prefer it to the yellow and use it exclusively in their work. They claim that it adds very materially to the appearance of a pattern. As every mechanic of taste knows, this is not true, and to blacken a fine piece of work de-

tracts more than adds to the looks of it. The only time, really, when a person is justified in using black varnish is when his work is so shabbily done that its many defects need to be concealed. Then the black answers well the purpose of covering a "multitude of sins." As a rule, the men who prefer the use of black to yellow varnish are poor workmen who are ashamed to have their shabby work exposed to the scrutiny of others. PATTERN-MAKER.

Tools for the Slotting Machine.

Editor American Machinist:

Noticing that in many shops is still used the old style of key tool-post on the slotter prompts the sending in of some more advanced designs.

Being desirous of increasing the output of the slotter, and more desirous of making the job a snap, I designed the tool-posts shown in the sketches, and they proved big money makers from the start, and the work was made more easy for the man running the machine.

These tool-posts were made to the dimensions given in the sketches. That in Fig. 1 would take roughing cuts 1 inch deep for yards, under a water cut, where the old keyed tool would slip after a few inches. It was also much more convenient to work with, as a tool could be changed without stopping the machine.

In Fig. 2 is shown a tool-post designed for the machining of deep recesses, and it proved a most rapid tool, as will be perceived in noting the width of roughing cut taken: 1⅝ inch, with a feed of 128 to the inch, under a water cut, in wrought iron, which was the regular thing.

It is quite evident that such work was a vast improvement over the old method of machining deep recesses with bar-steel tools, obsolete types that should be now seen nowhere about the modern slotter. After placing these two tool-posts into use, several hundred pounds of fine tool steel, in whole tool bars, were sent to the tool-dressers to be profitably used for other purposes.

Fig. 3 shows some of the new tools for the new tool-post. Fig. 4 shows the washer used under the tool-post, Fig. 1, showing how the tools are prevented from side-slip and, also how square-nose tools are placed absolutely square at the first setting.

FRANK RATTEK.

Manchester, N. H.

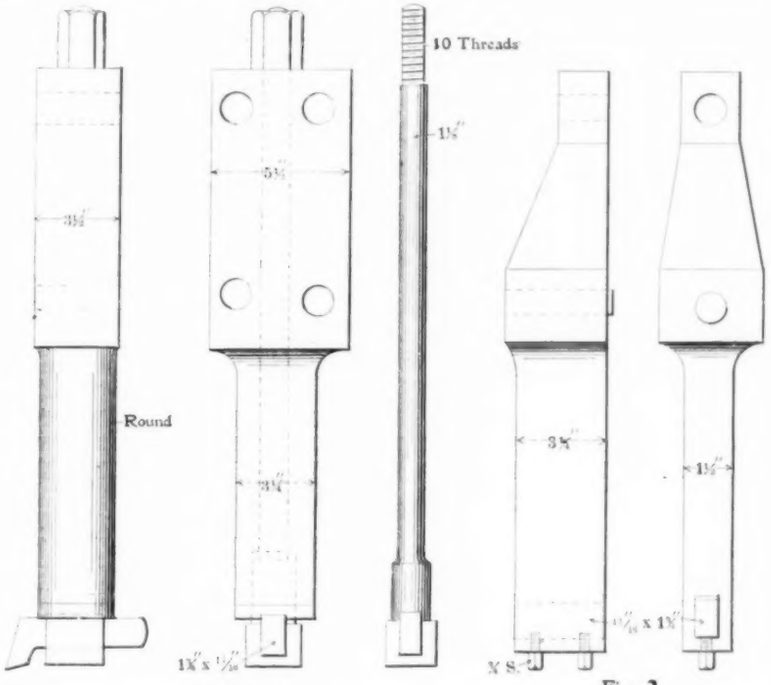


Fig. 1 Fig. 2

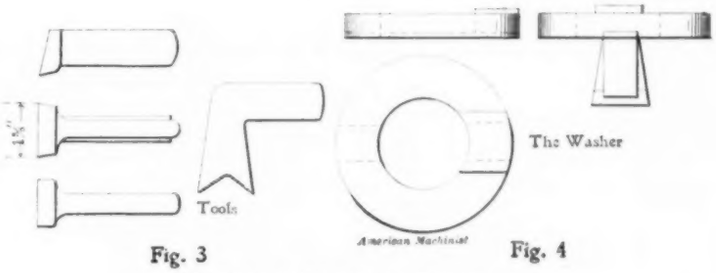
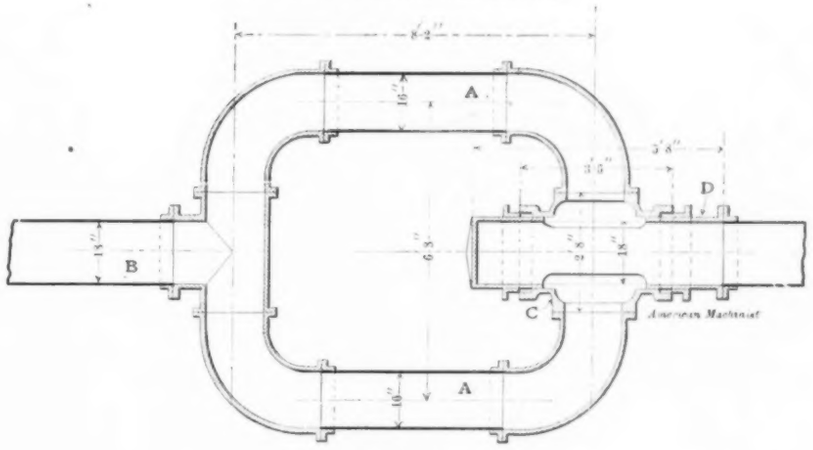


Fig. 3 Fig. 4

IMPROVED TOOLS FOR THE SLOTTER.



A NEW EXPANSION JOINT.

A New Expansion Joint.

Editor American Machinist:

The description of the expansion joint published in your issue No. 33 reminded me of one of our joints that somewhat resembles the one illustrated. As this style of expansion joint seems to give better service than any other, I hope the sketch herewith shown will be of interest to some of your readers.

It will be seen that the joint allows for the expansion in an 18-inch line and that it is perfectly balanced with two outside packings. The two passages *F* from the joint proper to end of the pipe at *B* were made 16 inches in diameter, so as to give ample passage for the steam as well as to make the joint rigid with symmetrical connections and strains. To make the joint at the least cost, as well as to keep everything as near to our standards as possible, we made all the parts that could be so made from standard patterns, thus making it necessary to make new patterns for the two special pieces *C* and *D* only.

ENGINEER.

Expansion Joints.

Editor American Machinist:

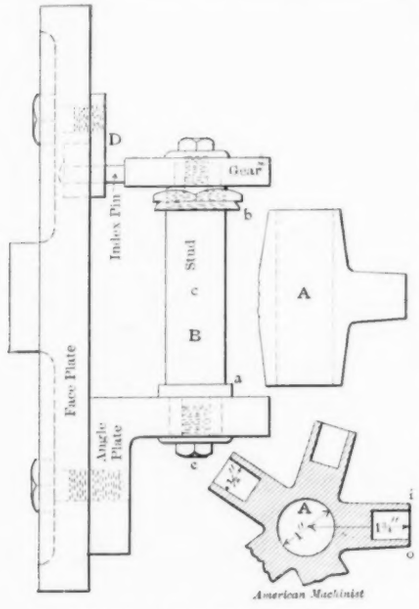
Kindly allow me to point out to your correspondent, "Steam Engineer," page 930, that just such expansion joints as he has drawn and described were regularly

manufactured by the Coldwell-Wilcox Company, of Newburgh, N. Y., as long ago as 1893, the only radical difference being that they used a brass plunger or sliding piece instead of iron, as shown by your correspondent. W. G. PACKER.

Boring a Five-Armed Spider.

Editor American Machinist:

We had some five-armed bronze spiders like *A* to be bored and faced true, and this is how we did it. We had no milling machine in the shop. The central hole was bored and the ends were faced to equal lengths on each side. Then a stud *B* was turned to fit the hole in the spiders, with a shoulder *a* on one end and a nut and a washer *b* on the other end, the distance between *a* and *b* being the same as the length of the spider hubs, so that tightening the nut would hold the spider securely.



BORING A FIVE-ARMED SPIDER.

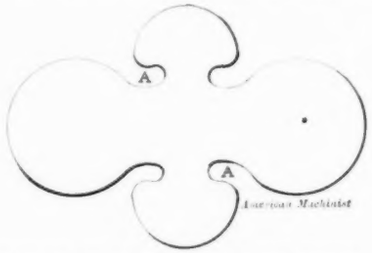
This stud was fitted to a hole in the face of an angle-plate with a bolt tapped into the end of it and a washer to hold the stud firmly in place on the angle-plate. The angle-plate was then bolted to the face-plate and set so that the stud *B* was true and central in both directions. This was done by setting a tool in the tool-holder and trying the spot *c* on each side with the point of the tool until the point would touch each side alike. This set the stud in correct position sideways. The tool was then tried against the shoulders *a* and *b* and the angle-plate was shifted until the point of the tool touched these alike, and that set the stud right lengthwise, and the angle-plate was then tightened firmly to the face-plate. On the outer end of the stud was a 30-tooth change gear held against a small shoulder on the stud by a washer and bolt tapped into the outer end. When the face-plate was in position the outer end of stud B stood directly over one of the slots in the face-plate, and to this slot was fitted the piece *D*, the tongue of it fitting the slot sideways, a cap bolt holding it in place and an index pin projecting into and just fitting one of the gear spaces.

For boring the first arm of the spider it was fastened securely on the stud, and the bolt *c* was slackened slightly, so that the stud could be turned in the hole in the face-plate, and the arm of the spider was brought central, or so that the point of the tool would touch equally at *o* and *i*. The bolt *e* was then tightened and the first arm of the spider was in correct position for boring. Before boring, however, the indexing was attended to. The gear on the end of the stud, not yet having been tightened, was slipped around, so that by sliding *D* in the slot the index pin would slip into one of the tooth spaces, and *D* was then fastened there and the gear was fastened by tightening screw *f*. After the first hole was bored *D* was slid along, so that the index pin cleared the gear teeth; screw *c* was slackened just enough to allow the stud to turn, and it was turned so that six teeth of the gear passed, when *D* and the index pin were slipped back into place, and after tightening up, everything was ready for boring the next hole, and so on. After all the holes were bored the hubs were brought to the same length by facing each successively with the same setting of the tool. H. A.

The Best Way to Make the Punch.

Editor American Machinist:

When submitting what seemed to me an improvement in many ways upon the solid punch previously described by Mr. William Doran, I did so with the idea that it was his intention to describe something that would be acceptable and profitable to the majority of your readers, and not only to those who are well equipped, as Mr. Doran must be, else he would not consider the cost of his forging "insignificant," as he says in his reply on page 1039, for while it is easy to find the smith "who knows his business," still it is not nearly so easy to find one "familiar with this class of work," one who can economically weld and forge a piece suitable for Mr. Doran's solid punch.



BAD SHAPE TO CUT IN A SOLID PUNCH.

How many of your readers, Mr. Editor, have such a man at their command? I venture to say very few. Still, I cannot see that the comparison made by Mr. Doran shows his method to be any quicker for anything but the simplest of dies, and certainly it can *never* be done in "one-half the time," while, if the punch is made as I advocate, the greater part of the work can be done by an apprentice, while the solid one will require expensive and exper labor throughout.

Supposing the shape of the punch was as shown in the sketch, decidedly undercut at *A*, as unfortunately it is frequently required to be, and for that reason I think it only right to suppose such a case, how could it be milled? Such corners would have to be left for the vise hand, who would submit them to a process of pecking and scratching with chisel and file, while with the punch whose shape is the same all the way back the most difficult outline can be followed by the shaper tool, and after that a clear sweep can be had in filing.

Mr. Doran emphasizes the feature of forming in one operation, which of course is good. But I can see no reason why that should demand a "punch and holder in one piece," as a punch sheared back for forming the given shape would greatly reduce the strain that it would otherwise have to withstand. And such a shape is applicable to all styles of punches. I have no doubt that Mr. Doran has, like myself, tried both ways, and perhaps many more, of doing such work, and he prefers the one which he described, while I am still unconverted to his way of thinking.

There is one admission I am willing to make which I feel sure others will understand, and that is that I cannot assert, as Mr. Doran does, that I "have not as yet had a corner break off," and for that reason I like to be able to repair quickly.

WILFRID J. THOMPSON.

Pittsburgh, Pa.

"Medicine" for Steel.

Editor American Machinist:

On page 923 Mr. W. Osborne speaks in decidedly skeptical terms of certain "secrets," "powders" or "medicines" for restoring burnt steel. I would like to inform him that for eight or nine years I have known of and used such a preparation, and if I had his address I would send him the recipe.

I have no reason to believe that this "medicine," as it was called by the first blacksmith whom I saw using it, will make spoiled steel "better than before," or that it will justify anyone in buying poor steel and trying to make good steel out of it, nor will it warrant the deliberate abuse or burning of good steel. But I know from experience that it will render valuable service where steel has been burned or maltreated under the hammer till it is full of flaws and about spoiled. For instance: I have often taken a common rock drill, a pick or a cold chisel which has been burned and hammered (I believe more tool steel is spoiled by the hammer than the fire) till it is full of

visible flaws and ready to fly to pieces at a touch of the hammer, and I have completely cured it, so that it would stand as much hard work as a good, new piece of the same steel, and that is saying considerable, especially in the case of the drill.

Heat the specimen to be treated somewhat hotter than is required for welding, roll or dip it in the "medicine" till it is thoroughly coated, bring it again to a welding heat, dip quickly in the "medicine" and hammer thoroughly—not to "drive the virtues in," but to be sure that all cracks and flaws are completely welded—then draw and temper the same as usual. If the specimen has considerable size, or if it still shows imperfections, repeat the dose. The result will surprise anyone who has not tried it, and I find it pays to have this stuff always handy to the forge, nearly as much so as borax or sand.

Anyone may try it for a few cents. It is simply carbonate of iron and powdered borax, equal quantities, mixed. It can be had at any drug store. An excess of borax will do no harm, as the hot steel will pick up the borax faster than the other, and after a time you will need to add more borax. It won't cost Mr. Osborne a dollar to try this, and it would be interesting, to me at least, to have his verdict upon it.

By the way, some months ago the "Echoes from the Oil Country" failed to appear for four or five issues, and I thought they had died out entirely. I was just about to write you a respectful remonstrance, when they appeared again, and I hope they will continue to echo as long as I read the "American Machinist."

I have never tried the above remedy on any of the fancy, self-hardening or special brands of steel, and can't say what the result would be.

The floating of finely divided particles of heavy substances in mediums of less specific gravity, discussed on page 948, has long been a matter of wonderment to me as well as to your other correspondent. Will not capillary attraction account for this to some extent? Thus, a particle of iron dust in air will have several particles of air attached to its surface by capillary attraction, and the group taken together will then have a specific gravity more nearly that of the surrounding air than would the iron alone. In other words, the particles of attached air will tend to "balloon" the iron.

Elliston, Montana. GEO. MACK.

Thickness of Plates Encastré.

Editor American Machinist:

In issue No. 37 Mr. Bruce is correct. I should have given the stresses used in the formula for flat plates encastré as published in issue No. 30.

The thickness of flat plates under a pressure is a subject that very few seem to know much about, and, as you say, it requires experimental investigation. It seems to me that someone with the time and money would confer a great favor on engineers if they could find it convenient to conduct such experiments.

The formula explained in your issue No. 30 was deduced, I think, by a man named A. Marichal. Whether he was a Frenchman, Dutchman or Russian, I don't know, but I suppose he gave a good explanation of his work and formula or the chief engineer from whom I obtained it and who used it for a number of years would never have taken it up, because there were pieces of work where he had to be very careful or he might have been responsible for a number of deaths.

In applying the formulas I always used a very low stress, as flat plates can't be fooled with when there is a pressure of 200 pounds of steam behind them. My reason for publishing them was not so much for use on the circular, square and rectangular plates as for such odd shapes as one finds in a marine engine, especially about the high-pressure cylinder, where sometimes a pressure as high as 250 pounds has to be carried. In such cases I have used a fiber stress of 1,200 pounds and very seldom go over this; corresponding values are used for other metals.

Prof. Unwin's formula for rectangular sections is about as unhandy and annoying as one wants to use when in a hurry. I knew of the difference existing between the two and preferred the one I send you, as the gain in time is worth a great deal.

GEORGE E. BARRETT.

Adjusting English Lathes.

Editor American Machinist:

Mr. L. O. Weyer, in his article on the "Uses of Micrometer Calipers" appearing at page 872, touches on one of the most common and aggravating jobs of the lathe hand, that of setting his lathe tail- or headstock parallel with the shears after the alinement has been disturbed, and I must say that his way out of the difficulty is very good.

In most of the English lathes that I have seen in the course of fifteen or sixteen years the headstock has been made adjustable for the turning of tapers (it is very seldom that they are fitted with a taper attachment and not always with a compound rest) and once the alinement has been disturbed it is a tedious job to set it right again, and especially so when it is required to bore a perfectly straight hole in a piece of work held in the chuck or strapped on the faceplate.

What I would suggest to makers of this type of headstock is that when the lathes have undergone the efficiency tests which all tools should undergo (whether they do or not is another matter) at which time the head will be in perfect alinement for boring, turning and facing, a line should be placed on the lathe bed at each end of the headstock, and on the head itself a small indicator set to this line.

This would also serve as a guide for the turner as to how his lathe head would be "for straight" and would save endless trouble and expense and possibly "language," as he would always be enabled to set his lathe head pretty correctly without any of the hit-and-miss business he has to resort to now.

I might also mention that in a great many English machine shops the men don't know what a "micrometer" caliper is, leave alone possess one. WM. WEBSTER.

Armley, Leeds, England.

Holding an Irregular Piece on the Drill Table.

Editor American Machinist:

We had a heavy job of boring to do on a large drill press on a casting hard to hold. Luckily there were two lugs projecting which could rest on the platen and we made good use of this by building a dam of putty around these and two of the slots in the platen, putting a cardboard bottom under these slots and then filling the space with melted babbitt. The result was that the piece was as firmly held as if of one piece with the machine. Undoubtedly some fine mechanic may say this might warp the platen, but what is the difference as long as it can't be noticed? It is probably easier to pour melted babbitt on a drill-press table without permanently warping it than to plane to a line with friction and shifting-belt shapers, or to keep a piece of work from shifting in the chuck of a turret lathe by a stationary mandrel which is a working fit in the work, though some people claim they can do these things. C. R.

Making Erasures on Tracings.

Editor American Machinist:

I note the inquiry of "Perseverance" concerning erasures on tracings, published in your issue No. 39. When I was studying engineering at Lewis Institute, Chicago, Prof. Chamberlain, who has the chair of engineering, made a very small motor for erasures on drawings to be held in the hand and run from a lamp socket, and on the shaft he put a circular eraser. I did not see it work, but it was reported to be a great success. GEO. S. HALEY, JR.

Circumferential Steel Tapes.

Editor American Machinist:

Noticing your editorial item at page 956, we call your attention to a steel tape we have been making for some time, a sample of which we take pleasure in sending you by this mail.

The length of the tape is 12 feet, marked either in feet and inches or in consecutive inches to 144, as preferred, on one side. On the opposite side it is marked in what we term diameter inches—*i. e.*, each division is 3.1416 inches in length. Before the zero line is an extra diameter inch, divided into 64 parts. To obtain the diameter of a circle, place the tape around its circumference and take the reading opposite the

line falling in the inch divided in sixty-fourths. The even inches are indicated by this line and the fractions are read in the finely divided space opposite this line, reading back from zero.

The tape is very convenient for certain purposes, as you say, and the price —— is not exorbitant. THE LUFKIN RULE CO.

Saginaw, Mich.

The Steel Tape for Circumferential Measuring.

Editor American Machinist:

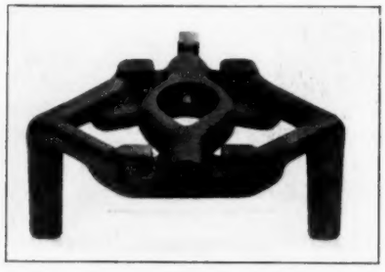
I notice in your issue No. 34 a paragraph saying that it is suggested there would be welcomed in the trade a steel tape with marks 3.1416 inches part, etc. Such tapes have been made for several years past by Thos. Broadbent & Sons, of Huddersfield, England. A. SMART.

Erith, Kent, England.

Some New Things.

AN EQUALIZING LATHE DOG.

Most machinists who have experimented with or given attention to the problem of an equalizing driver or dog for lathe work know the value of such a device in lessening the lateral strain upon the work and the lathe spindle, conducing therefore to

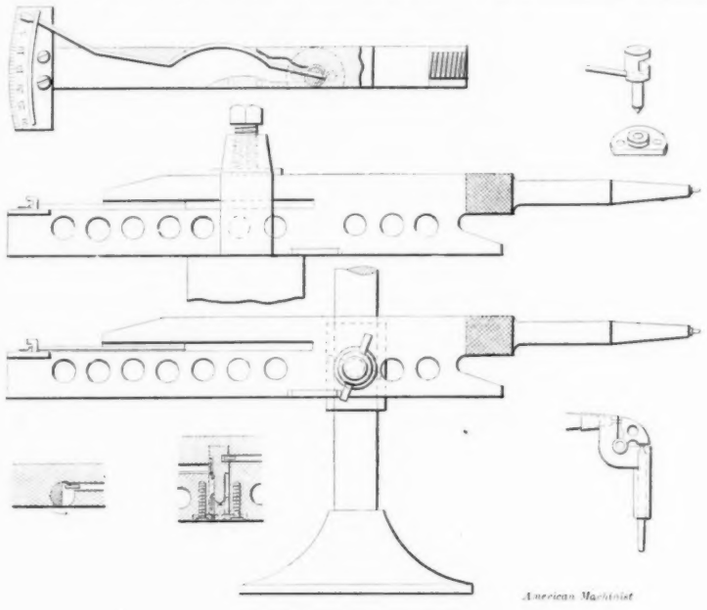


AN EQUALIZING DOG.

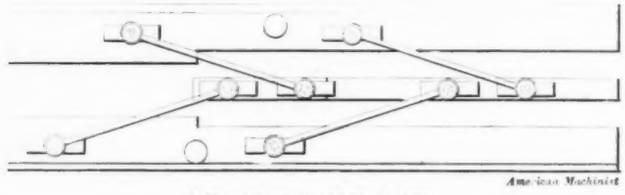
accuracy, and also in avoiding chattering. The trouble with most such devices is their expense as compared with an ordinary dog or driver, and we therefore take pleasure in showing an engraving of an equalizing dog which is made of two castings put together without machining, and one of these being tapped for set-screw in the ordinary way. It will be seen that one of the castings has two tails for engagement with the face-plate and that the other is free to slide across it for a limited distance, which it will do until the work is driven equally from opposite sides. As the fit of the two pieces can be, and in fact should be, loose, no fitting is required, but they are put together as they come from the sand, with a little smoothing up. This dog is the subject of a recent patent to Mr. Karl J. Holst, New number 290 Pacific avenue, Jersey City, N. J.

A MICROMETER INDICATOR.

The cut shows a recently patented device for use in the toolroom or in connection with fine machine work. The stock of the instrument enables it to be held in a lathe tool-post or to be clamped by any of the holes to the side of a surface gage as shown. The micrometric measurements are normally taken in the direction of the axis or longitudinal line of the instrument, but when the little attachment shown at the lower right-hand corner is slipped on to the end of it the indications may be taken sideways, either vertically, horizontally or at any angle. A light rod or needle moves easily through the projecting horn of the instrument, the outer end being hardened and coming in contact with the work to be indicated. Near the middle of the instrument is a vertical post which turns freely on its axis, a helical spring around the lower and smaller part of it taking up the slack and keeping it always crowding in the same direction. The upper or larger part of the post has a notch cut horizontally into the center of it with a flat end coincident with the axis. The inner end of the needle presses against this flat surface near the periphery of the post, so that it tends to turn the post, but with a very short leverage. The post carries a long pointer which traverses a graduated arc from which readings may be taken. The sections and views given show the construction clearly.



A MICROMETER INDICATOR.



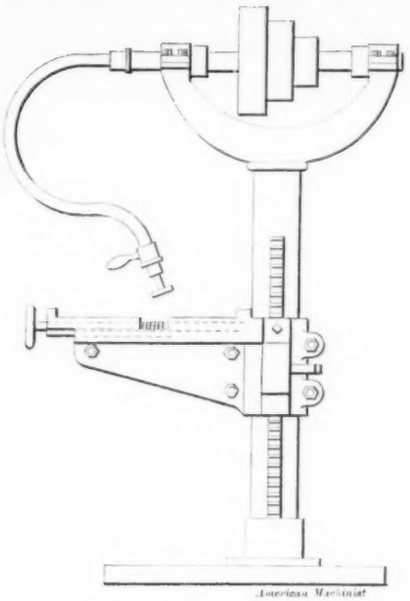
IMPROVED PARALLEL RULER.

AN IMPROVED PARALLEL RULER.

The draftsman now seldom uses, or, indeed, has in his kit, a parallel ruler, its work being done by the triangles, and it is doubtful if the parallel ruler can again be brought into general use. One objectionable feature of the old parallel ruler is eliminated by the recently patented device shown in the cut. The old parallel ruler in opening swung off to the side, while this one will not do that except on compulsion. In opening it the moving blade may be moved obliquely, within certain limits, either to the right or to the left, or it may be moved at right angles to the blades, still retaining its parallelism. The patent on the instrument covers a number of details of construction, such as automatic means for taking up lost motion in all the joints, the adjustment of one of the rods to correct the alinement, etc.

A STONE-CARVING MACHINE.

The cut, from a recent patent, shows at a glance the essential features of this machine. The table is raised or lowered and the chuck-jaw is moved in or out to hold the work securely and to bring it to the hight most convenient for the operator, who moves the milling cutter by hand over the surface of the stone, cutting or carving it as desired. The use of the flexible shaft to drive the milling cutter suggests the employment of it for the lighter milling of the metals. The cutter of course could not be manipulated by hand, as in stone cutting, but the sleeve through which the spindle runs, and to which the handle is attached, might have a spherical exterior, and this might be held in a corresponding clamp bracketed to the post, which would permit the ready changing of the position or inclination of the cutter



A STONE-CARVING MACHINE.

within an extensive range. The work might be secured to the platen and fed or moved in either direction, as with existing machines.

A reader wants to know the best method of procedure for threading in the lathe a rod 1 inch in diameter and 16 feet long, thread to be cut the entire length 8 per inch. Any of our readers who may know a practical method of doing this will confer a favor by sending it in. As we understand it, die work is not wanted, but the thread is to be chased.

The Grant Tool Company, of Franklin, Pa., have issued a very neat illustrated folder, which constitutes an invitation to the opening of their new works, which took place at Franklin on the 2d inst. The folder indicates that this company has now very thoroughly built and equipped shops for the construction of machine tools.

Those who were at the time most interested in securing the passage of the so-called "naval personnel" bill are now forced to admit that the result we prophesied of its workings has come to pass and that it is a complete failure, so far as strengthening the engineer corps is concerned. It has given many engineers what they deserved to have—*i. e.*, the real rank and privileges to which their attainments entitled them, but many of them now show a preference for the quarter-deck and there are, it seems, few if any other officers that take a fancy to engineer's work and that show a willingness to take the places of the men who have deserted the engineer corps. It is understood that Rear-Admiral Melville will in his forthcoming report make some further recommendations regarding the matter and will urge the establishment of a post-graduate course at Annapolis for instruction in engineering. He will advise the erection and equipment of a large building for the purpose.

Manufacturers.

The Detroit Southern is grading for new shops at Napoleon, O.

The Pittsburgh Steel Hoop Company will erect a plant at Monessen.

The Mecklan Wagon Company will build large works at Gadsden, Ala.

The Federal Lead Company intends to build a smelting plant at Alton, Ill.

The Anniston (Ala.) Carpet Company is preparing to enlarge its plant.

The Western Wheeled Scraper Company, Aurora, Ill., is building additions.

The Acme Foundry Company, Cleveland, O., is planning to build a new plant.

A new factory will be built for the Standard Varnish Works, at Chicago, Ill.

J. S. Kilgore, of Anderson, Ind., will build a heading and stave factory at Paducah, Ky.

The Breckenridge plant at Toledo, O., of the American Can Company has been burned.

The plant of the Avondale (Ala.) Ice Factory is reported to have been destroyed by fire.

The Hartford (Conn.) Foundry Company has broken ground for two additions to its plant.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 22.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Gas engines. Northern Engin'r'g Works, Detroit, Mich.

Wanted—Large horizontal boring mill. Materne Mfg. Co., St. Louis, Mo.

Light machinery built to order. American Machine Co., Wilmington, Del.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas, Bridgeport, Ct. Send for index sheet.

El. c. & mech. designing & drawing, also ideas developed. Box 709, Schenectady, N. Y.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

See 12 presses & dies for sheet-metals, S. E. cor. Machinery Hall, Buffalo Exposition. Ferracute Mch. Co., Bridgeton, N. J.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

Wanted—Address of parties who are fully equipped for making tools for plumbers' brass work. Box 103, AMERICAN MACHINIST.

For Sale—Blueprints for 1¾ H. P. gasoline motor; full size; all details and dimensions; $4. Address Box 102, AMER. MACHINIST.

Gear and Milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears. Catalog of small tools free. R. M. Clough, Tolland, Conn.

For Rent—Complete, fully equipped modern machine shop in Alexandria, Ind.; steam heat, electric light and power free; 1,000 hours' work per annum guaranteed; particulars on application. "Glass," care AM. M.

Purchaser for small manufacturing plant; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Madison, Wis.

A prominent typewriter manufacturing company have just opened a department for the manufacture and sale of novelties. Responsible parties having something of this class to turn out will oblige by addressing "Work," care AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

M. D. Patrick, industrial agent Seaboard Air Line Railway at Pinebluff, N. C., the well-known winter health resort, offers building and power free to parties wishing to start manufacturing in a small way with view of enlarging; no doubt many will accept this generous offer. Box 104, AMER. MACHINIST.

For Sale or Trade—Machine shop, 40x40; 500 ft. glass light; first-class location here; 1 Putnam lathe, 20 in.; 1 Lodge & Davis drill press, 32 in.; 1 New Haven drill, 16 in.; 1 6 in. iron shear, 1 emery wheel and stand, 1 steam engine, 6 H. P.; upright boiler, Fritze make; 41 ft. 2 3-16 shafting, complete with hangers, and lot of small tools. Don't write unless you are in for business. Martin Hamm, Strasburg, Shelby Co., Ill.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Practical mechanical draftsman wishes position. Box 111, AMERICAN MACHINIST.

As superintendent of machine shop, by a thorough mechanic; 20 years' experience. Box 98, AMERICAN MACHINIST.

Position as superintendent or foreman on the erection of machinery, power plants, etc., by experienced engineer. Box 99, AM. MACH.

Mechanical draftsman, technical graduate, 14 years' experience, chief draftsman for several years, desires position. Box 109, AM. M.

Competent machinist, with up-to-date experience as draftsman, foreman and superintendent, is open to engagement. Box 83, AMERICAN MACHINIST.

Am a busy man, but will make a desirable change; should you desire a good superintendent for your machine shop write me. Box 92, AMERICAN MACHINIST.

Engineering graduate, age 30, shop and drawing-room experience, now holding position of superintendent, desires change. Address Box 108, AMERICAN MACHINIST.

A competent machine tool salesman, employed by a well-known firm, desires a change; satisfactory reasons for changing and good references given. Box 106, AMER. MACH.

A practical foreman and superintendent, with 25 years' experience in engines, dynamos and general machine shop work, desirous of position. Address Box 112, AMER. MACH.

Engineer, electrical and mechanical, executive experience, desires to represent manufacturer in New York city; salary and commission; able worker; references. "Effort," care AMERICAN MACHINIST.

Mechanical engineer, 18 years' experience on marine and stationary steam engines, general and special machinery, wants position as chief draftsman or superintending engineer. Address Box 115, AMERICAN MACHINIST.

Wanted—Position as assistant superintendent or draftsman, by engineer with 9 years' experience in the design, construction and erection of Corliss engines and general machinery. Box 114, AMERICAN MACHINIST.

A young man, technical graduate, has had experience as machinery salesman and in building and inspecting machinery, also charge of 150 men, is now open for a permanent position. Box 113, AMERICAN MACHINIST.

Wanted—Position by general foreman or superintendent of extensive experience on special machinery, gasoline engine and tool building; up in modern methods and tools, and a hustler. Address Box 107, AM. MACH.

First-class toolmaker desires position; thoroughly posted on jigs, fixtures, gages, etc., for economical production, also punches, dies and sheet-metal tools generally; accustomed to designing, estimating and handling help. Box 100, AMERICAN MACHINIST.

Superintendent wishes to correspond with parties desiring the services of a practical, thorough mechanic, up to date in modern

Beattie & Hobson and Sanders, Swann & Co., Atlanta, Ga., have bought land for a cotton compress.

The Berlin Wheel Company, Berlin, Conn., contemplates the erection of a large addition to the factory.

D. A. Titzel's spoke and handle factory at Greenville, near Wilkesbarre, Pa., has been destroyed by fire.

The Cleveland Car Company, Cleveland, O., will erect another building which will double the present output.

It is said that Howell & Hensler, proprietors of a rolling mill in Chicago, will build a factory in Jersey City.

The Stanley Rule & Level Company, New Britain, Conn., will raise its factory and will build a pump house.

P. J. Stelling & Co., Davenport, Ia., are building a new wood-working shop to replace one that was burned.

H. P. Cameron Electric Manufacturing Company will, it is said, move to Ansonia, Conn., from Syracuse, N. Y.

W. J. McCollum, of the McCollum Steel Wagon Company, of Chicago, is looking for a factory site in Kentucky.

The explosion of a 40 horse-power boiler has wrecked the city electric light and water works plant of Wilmar, Minn.

An addition is being built to the plant of the Ohio Motor Company, manufacturer of gas engines, etc., Sandusky, O.

The Hill Clutch Company, Cleveland, O., has purchased ground adjoining its present shops and will erect an addition.

The Lawrence Machine Company, Lawrence, Mass., is building an 84x120-foot extension to its Island street plant.

The Aird-Don Company, plumbers' supplies, Troy, N. Y., is excavating to build a tube works, 40x120 feet, at Watervliet.

The foundations for the new machine shop for the Vulcan Foundry & Machine Company, New Castle, Pa., have been completed.

The Berkshire Street Railway Company has awarded the contract to build its new power station, 110x36 feet, in Pittsfield, Mass.

The Coulter & McKenzie Machine Company, Bridgeport, Conn., has purchased land which is said to be intended for a factory site.

C. B. Cummings & Son, of Norway, Me., will build a mill at Bemis, where birch will be worked up into dowels and spool stock.

The Crescent Carriage Company, organized recently at Pontiac, Mich., is preparing to erect a four-story building, 80x160 feet.

Charles H. Bartlett, proprietor of the novelty works at North New Portland, Me., is to erect a wood-working plant at Bingham.

The Southern Railway shops at Memphis, Tenn., are to be moved to Sheffield, Ala., where work upon the new shops has already begun.

The Bay State Mills, at Lowell, Mass., of the American Woolen Company, are to be enlarged. Work is progressing on the foundation.

A four-story addition will be built to the plant of the Heywood Brothers & Wakefield Company, manufacturer of chairs, at Gardner, Mass.

A considerable portion of the works of O. J. Beaudette & Co., manufacturers of carriages and woodenware, Pontiac, Mich., has been burned.

John Slip and others, of Chillicothe, O., have bought timber land bordering on the Dismal Swamp, Va., and will build a large sawmill.

The Schwarzschild & Sulzberger Packing Company, of Kansas City, will locate a packing plant at South Omaha, estimated to cost $1,250,000.

Situations Wanted—Cont'd.

methods, duplication of work, cost-keeping systems, shop management; best references furnished. Box 89, AMERICAN MACHINIST.

By man, 26, assistant to manager or superintendent machine works; will take charge of orders, systems, details; organize and direct same; make inspections, etc.; fair technical education; first-class ability; 5 years' in like position; very best references; state salary. Address "Twenty," Box 101, AMER. MACH.

Factory superintendent seeks engagement with manufacturing concern desiring the service of a practical mechanic; fair draftsman, with large experience in designing of special jigs and fixtures for the rapid production of good work at the lowest possible cost; can handle large number of men and force production; held similar position for 7 years with one concern employing 500 hands; East preferred; age 40; good references from responsible men. Box 110, AMER. MACHINIST.

Help Wanted.

Wanted—A first-class toolmaker, by The Lane & Bodley Co., Cincinnati, O.

Wanted—A first-class draftsman familiar with paper machinery. Box 41, AM. MACH.

Wanted—First-class designer, experienced in pump work. Box 105, AMER. MACHINIST.

Wanted—Capable patternmaker. Apply New York Agricultural Works, Boonton, N. J.

Molders; 35c. per hour; engine and general job work; no bench men. Denver Engineering Works, Denver, Colo.

Wanted—Draftsman on steam pump work. Address, giving experience and wages expected, Box 695, Du Quoin, Ill.

Wanted—Iron machine shop foreman, familiar with valves and fittings; none but experienced men need apply. Box 93, AM. M.

Wanted—Foreman for machine shop, experienced in construction large valves and hydrants; location, near Troy. Box 94, A. M.

Wanted—A smart tracer, at once. Apply, stating age and salary required, A. Ransome & Co., Ltd., Stanley Works, Newark-on-Trent, England.

First-class brass molder wanted as working foreman in a small brass shop near New York; references required. Address Box 43, AMERICAN MACHINIST.

Wanted—A young man with some knowledge of drafting; state experience and wages expected. Address "Worcester County," care AMERICAN MACHINIST.

Wanted—First-class draftsmen on marine engine work. Gas Engine & Power Co. and Charles L. Seabury & Co., Consolidated, Morris Heights, New York City.

Good patternmakers, both wood and metal, desiring steady employment, will find it to their advantage to apply to the General Electric Co., Schenectady, N. Y.

Wanted—First-class machinist for 10 ft. boring mill; also toolmakers and lathe hands; good wages; steady work. Apply Michigan Brass & Iron Works, Detroit, Mich.

Wanted—Draftsmen experienced on direct-current motors and generators; give full particulars as to experience and salary expected. Address "Draftsman," care AMER. MACH.

Wanted—A foreman on machine tool work; must have experience in both lathe and vise work; permanent position and good salary to right man. Address U. C. Y., care AM. M.

We invite applications from machinists and molders; give references, experience and wages expected; work on air compressors. Franklin Air Compressor Co., Franklin, Pa.

Wanted—Three or four good machinists to work in shop in Western Pennsylvania building engines and general machinery; give age and experience. Box 96, AMER. MACHINIST.

Wanted—Foreman of business ability and mechanically skilled to supervise construction and assembly of fine clock movements used in a specialty. Address Box 97, AMER. MACH.

Wanted—Two good mechanical draftsmen, experienced in general and heavy work; applicants will please state age, reference and salary required. Box 91, AMER. MACHINIST.

Wanted—Experienced mechanical draftsman, energetic and systematic; location, Trenton, N. J.; give full particulars and salary expected. Address Box 85, AMER. MACH.

Wanted—Several young married men, experienced on lathe or planer, also man for manufacturing work on universal grinder. Apply at once to Hyatt Roller Bearing Company, Newark, N. J.

Wanted—Brass foundry foreman who understands molding machines and capable of handling men to best advantage; one familiar with valves and fittings preferred. Box 95, AMERICAN MACHINIST.

Foundry foreman wanted; one who is competent to take charge of a new shop located near New York, fitted with all improvements to do the heaviest class of work. Address "Marine," care AMERICAN MACHINIST.

Wanted—Three all-round machinists, accustomed to jig work and repairs on small automatic machines; permanent position for right men; state experience and wages expected. Address "Worcester County," care AM. M.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—A crackajack turret lathe operator who has sufficient executive ability to assume foremanship later on, and who can demonstrate his fitness for promotion by the production of his machine. Address Box J, AMERICAN MACHINIST.

Wanted—Machinists; a few good vise men in a small town in Ohio to work on small, close work; good wages and steady work to competent and reliable men; in answering, state whether union or non-union. Address Box 84, AMERICAN MACHINIST.

Wanted—Machinists, boilermakers, blacksmiths, patternmakers, ship fitters, to go to San Francisco; good wages, continuous employment guaranteed by yearly contract; answer by mail only, stating age, experience and reference. Address C. T. B., Room 406, Park Row Building, New York City.

Salesman to sell machinery which requires a technical experience and education to handle; applicant must have engineering and selling experience and ability to handle and negotiate large contracts; give age, experience, references, how soon at liberty and salary expected. Box 90, AMERICAN MACHINIST.

For Sale.

One lot of 26 in. and 32 in. lathes, new, Gleason pattern; Pittsburgh Machine Tool Co., build.

PITTSBURGH MACHINE TOOL CO.,
10 Darrah St., Allegheny, Pa.

Receiver's Sale of Plant of Cataract Tool & Optical Co.

OF BUFFALO, N. Y.

SUPREME COURT, ERIE COUNTY, N. Y.

In the matter of the Voluntary Dissolution of the Cataract Tool & Optical Company.

Pursuant to an order of this Court granted the 20th day of September, 1901, I will offer for sale, on the 14th day of October, 1901, at 10 o'clock in the forenoon, at the plant of the Cataract Tool & Optical Company, No. 357 Seventh street, Buffalo, N. Y., said plant, the stock in trade, fixtures, patents and everything connected with same, to the highest bidder for cash.

The undersigned reserves the right to dispose of said property in bulk or in parcel at whichever bid will bring the highest price for the assets of said corporation.

Among the assets of said corporation which will be offered for sale are:

6 Blaisdell Lathes, 11 to 16 in. swing, 5 and 6 ft. beds; 1 Brown & Sharpe No. 1 Universal Miller; 1 No. 1 Cincinnati Universal Miller; 1 Brown & Sharpe No. 2 Universal Grinder; 1 Brown & Sharpe No. 0 Miller; 1 Cincinnati Universal Cutter Grinder; 1 1½ inch Waterbury Farrell Foundry Power Press; 1 Dwight Slate Machine Co. 2-spindle Drill Press; 1 Barnes 20 in. Drill; 12 Cataract Precision Lathes, with accessories; 1 Ohio Planer, 24 in. x 24 in. x 6 ft.; 1 Warner & Swasey Screw Machine; De Zeng's Refractometers, finished and unfinished; Corneal Microscopes, finished and unfinished; Telescopic Sights and Mountings, finished and unfinished; Cataract Precision Lathes and accessories, partly finished; Shafting, Pulleys and Belting; all fixtures and tools for the manufacture of the Cataract Precision Lathes and optical goods; the United States patents for the Rifle Telescopes, sights and mountings, and Refractometers; the English letters patent for Refractometers.

Said plant and stock will be open for inspection to prospective purchasers at any time prior to said sale upon application to the Receiver or his attorney.

Dated, Sept. 21, 1901.

MOSES SHIRE,
Temporary Receiver, 934 Prudential Building, Buffalo, N. Y.

AARON FYBUSH, Esq., Attorney for Receiver, 304 Ellicott Square, Buffalo, N. Y.